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Inequities and disparities in reproductive health: HIV and STIs

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Inequities and disparities in reproductive health: HIV and STIs

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Editorial: Inequities and disparities in reproductive health: HIV and STIs

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Editorial on the Research Topic
Inequities and disparities in reproductive health: HIV and STIs

Reproductive health affects everyone; however, there are still massive disparities in outcomes and access to care. This editorial contains contributions that bring together research findings on some of the most important inequity issues in the field of reproductive health, including gender, HIV, drug inequity, intervention mapping, determinants of contraceptive use, and associated factors and predictors of loss to follow-up in HIV programs in different country contexts.

A total of thirteen (13) submissions were received for this research topic, with nine accepted and four rejected. The published studies encompass both original research and articles involving secondary data analysis, along with one perspective paper. Three studies from Ethiopia focused on risky sexual practices and associated factors among individuals on antiretroviral therapy (ART) and also examined geospatial variations and determinants of contraceptive utilization among married women of reproductive age, together with the incidence and predictors of loss to follow-up among pregnant and lactating women in the Option B+ Prevention of Mother-to-Child Transmission (PMTCT) program.

The study by Salato et al. among 398 adults living with HIV in South Ethiopia who were undergoing ART revealed a high prevalence (43.7%) of high-risk sexual practices in the six months before the study took place. The results indicated that non-disclosure of HIV status, alcohol consumption, and poor social support were significantly associated with these risky behaviors. The study by Terefe et al. aimed to identify geospatial variations in and determinants of contraceptive utilization among married women of reproductive age in Ethiopia, revealing comparatively low contraceptive usage with considerable regional variation. The study by Azanaw et al. on the incidence and predictors of loss to follow-up among pregnant and lactating women in the Option B+ PMTCT program showed a low incidence of loss to follow-up, which was lower than that reported in the majority of African countries but slightly higher than the World Health Organization (WHO) target.

Gedefie et al. utilized multi-level analysis to assess the prevalence and determinants of HIV among women of reproductive age (15–49 years) in Africa from 2010 to 2019. This study discovered that the highest percentage of HIV was found in Lesotho (23.98%), followed by South Africa (19.12%) and Mozambique (14.67%), emphasizing the need

for targeted public health intervention strategies to prevent HIV transmission in these groups.

A systematic review by Zhan et al. examined the prevalence of mental conditions among young people living with HIV (YLWH) and found a heightened risk of mental health issues (24.6% of the participants had depression and 17.0% had anxiety) in this population, underscoring the necessity for targeted interventions to promote the mental health and well-being of YLWH.

Other contributions to this research topic included a qualitative study to understand inequalities in the provision of adolescent sexual and reproductive health services in selected regions of Zambia. The article by Munakampe et al. found that while Zambian adolescents were aware of and had access to common services and commodities such as male condoms, health education, and HIV counseling and testing, availability was hampered by access-related barriers such as frequent stock-outs and insufficiently trained healthcare providers. Accessibility was further reduced during the COVID-19 pandemic lockdown, compounded by low accessibility of sexual and reproductive health (SRH) services among adolescents, which led to the use of alternatives such as herbal medicine and the perpetuation of myths and misconceptions.

Another article by Torres-Cortés et al. sought to promote equity in adolescent health in Latin America through an exploratory sequential mixed-methods study that included literature reviews, focus groups, individual interviews, and intervention mapping to inform the design of a comprehensive sex education program. The authors showed a statistically significant increase in protective skills related to sexuality among all participants following the intervention. Finally, two contributions from the United States (Chory and Bond; Hammond et al.) discussed access to PrEP (pre-exposure prophylaxis) and other sexual health services for cisgender women and the use of PEPFAR (the U.S. President's Emergency Plan for AIDS Relief) to promote equity in access to HIV medications.

Conclusion

The papers in this research topic highlight significant differences in contraceptive use and disparities in access to HIV and STI prevention and treatment in Ethiopia, Zambia, Latin America, and the U.S., and call for the urgent need for targeted interventions, policy reforms, and greater community engagement.

Author contributions

ML: Conceptualization, Writing – review & editing, Writing – original draft. RO: Writing – review & editing, Writing – original draft. CJ: Conceptualization, Writing – review & editing, Writing – original draft.

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Leveraging PEPFAR for HIV drug equity

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Introduction

The only manufacturing company of cabotegravir, ViiV Healthcare, has potentially altered the state of HIV treatment in the developing world by agreeing to voluntarily license the drug cabotegravir for generic production and distribution in all LICs and lower-middle LICs (1). Access advocates had been calling on ViiV Healthcare, which began selling the drug in the European Union in December 2020, to license the drug to generic manufacturers voluntarily. Yet, as of October 2022, only Zimbabwe has approved the drug for sale, with most countries citing the cost of the drug as the reason not to move forward with approval (2). The necessity for more equitable pricing is apparent, as the countries hardest hit by HIV in sub-Saharan Africa face a long wait to get the drug (3). ViiV has set the cost of treatment at 22,200 USD annually, but prices higher than 100 USD annually for generic oral PrEP are too high for many low and middle-income countries (LMICs) (2, 3).

Discussion

The new HIV medication, cabotegravir, has shown increased effectiveness at preventing infection than the standard method of pre-exposure prophylaxis (PrEP) (3). In particular, cabotegravir has shown increased effectiveness over oral daily tenofovir diphosphate plus emtricitabine (TDF-FTC) for HIV prevention in women (3). Experience with oral PrEP shows that many people find it challenging to take a pill daily, while others are reluctant because of HIV-related stigma (4). Taking long-acting injectable cabotegravir every 2 months can help overcome many of the objections users may have (5). Another issue with oral PrEP has been that even though demonstration projects were funded and started in the years following proof of efficacy, little coordination among funding and implementing agencies dragged out the incorporation of the drugs into high-quality programs (4). These insights from oral PrEP programs offers essential lessons for the delivery of cabotegravir for PrEP.

Despite the many potential benefits of implementing cabotegravir for PrEP, ViiV has been, according to some critics, slow to secure deals with generic manufacturers (6, 7). Calls to celebrate a changing tide in the pharmaceutical game are thus premature (1). Generics are still 4–5 years away, and until then, ViiV Healthcare will likely be the sole

manufacturer of cabotegravir (1). There are other obstacles to providing the drug. HIV may develop resistance to cabotegravir in people already infected with HIV, and this resistance hampers current HIV treatments (2). Thus, time-consuming, and costly sensitive HIV tests are administered in the United States before approving the drug for each patient (2). International funding will be vital in making such tests available if regulators determine that these tests are needed. Furthermore, to avoid the issues with the global rollout of oral PrEP, demonstration projects need to be big and fast-acting to overcome people's hesitancy to ask for the drug (2). Central to combating stigma are increasing awareness, addressing misinformation or mistrust, and promoting effective use. Users also prefer to access PrEP in non-clinical settings, yet cabotegravir is injected in the buttocks, requiring clinical privacy (4). However, it is possible to have community-based drop-in centers offering comprehensive HIV prevention services (4). For cabotegravir to be game-changing, funds must be allocated to these supporting tasks. African LICs face increasing demand from their citizens to access HIV medication to accommodate the surges of cases (3). A stable population must require sustained ongoing use for a high-quality program to incorporate cabotegravir.

Conclusion

A major potential solution is to use the clout of the President's Emergency Plan for AIDS Relief (PEPFAR), other donors, and national ministries of health to negotiate a price and volume guarantee that ensures a sustainable supply until generics are registered and readily available in approximately 4–5 years. While the current infrastructure amassed through PEPFAR is being used for testing and treatment of HIV, PEPFAR has not made a real attempt to utilize its funds to acquire cabotegravir (6). In fact, in July 2022, PEPFAR's Scientific Advisory Board (SAB) began discussions to procure the drug as ViiV Healthcare has promised to drop the price in certain low-income countries (LICs) (6). PEPFAR funding, which has provided 3.8 billion dollars for HIV services, should be allocated for cabotegravir acquisition (8).

We urge other donors and national ministries of health to negotiate a price and volume guarantee that ensures a sustainable supply to existing programs (1). Since ViiV is committed to allowing cabotegravir to be replicated by generics manufacturers, PEPFAR can function as a stopgap until the existence of generics lowers the price. Currently, the World Health Organization (WHO) is attempting to find a way for PEPFAR to implement injectable cabotegravir (9). The solution lies in PEPFAR to combat HIV in LICs and help achieve HIV equity. African LICs would benefit from leveraging PEPFAR networks, resources, and facilities to acquire and distribute cabotegravir. LIC health ministries must work with PEPFAR and other donors to treat HIV with cabotegravir and use the funds accessible to PEPFAR to acquire cabotegravir to allow for future HIV independence in LICs.

Author contributions

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Incidence and predictors of loss to follow-up among pregnant and lactating women in the Option B+ PMTCT program in Northwestern Ethiopia: a seven-year retrospective cohort study

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Introduction: Although Ethiopia has implemented the Option B+ program over the past 7 years, loss to follow-up among HIV-positive women remains a major problem for antiretroviral therapy (ART) treatment. This study was conducted to investigate the number of women who dropped out of follow-up after the Option B+ program.

Methods: A retrospective follow-up study was conducted among 403 pregnant and lactating women between June 2013 and December 2019 at health facilities in Northwest Ethiopia. The Cox proportional hazards regression model was used to identify predictors of loss to follow-up. The results were reported as hazard ratios with 95% confidence intervals (CIs) at a significance level of $p = 0.05$.

Results: The overall incidence rate of loss to follow-up was 9.4 per 1,000 person-months of observation (95% CI: 7.40–11.90). According to the multivariable Cox regression, rural residency [adjusted hazard ratio (AHR): 2.30; 95% CI: 1.08–4.88], being a Muslim religion follower (AHR: 2.44; 95% CI: 1.23–4.81), having no baseline viral load measurement (AHR: 4.21; 95% CI: 2.23–7.96), being on ART before enrolment (AHR: 0.30; 95% CI: 0.15–0.62), having drug side effects (AHR:1.82; 95% CI: 1.01–3.33), same-day ART initiation (AHR: 3.23; 95% CI: 1.53–6.84), and having suboptimal adherence level (AHR: 3.96; 95% CI: 2.18–7.19) were significant predictors of loss to follow-up.

Conclusion: The incidence of loss to follow-up is lower as compared to evidence from most African countries but slightly higher than the WHO target. It is better to strengthen and expand viral load measurements for all women and to pay attention to women residing in rural areas with fair or poor adherence levels.

KEYWORDS

HIV, women, loss to follow-up, option B+, PMTCT, Northwest Ethiopia

Abbreviations

AHR, adjusted hazard ratio; AIDS, acquired immunodeficiency syndrome; ART, antiretroviral therapy; CD4, cluster of differentiation T-4 cells; CHR, crude hazard ratio; CI, confidence interval; CPT, co-trimoxazole preventive therapy; eMTCT, elimination of mother to child transmission; HIV, human immunodeficiency virus; LTFU, lost to follow-up; MUAC, mid-upper arm circumference; OI, opportunistic infections; PMTCT, prevention of mother to child transmission; WHO, World Health Organization.

Introduction

Globally, an estimated 180,000 new pediatric infections were reported annually in 2018 (1). Mother-to-child transmission (MTCT) accounts for 90% of these new pediatric infections and may be transmitted *in utero*, labor, delivery, or breastfeeding (2). Without any intervention, MTCT ranged from 15% to 45%. However, antiretroviral treatment and other interventions can reduce this risk to below 5% in breastfeeding women and 2% in non-breastfeeding women (2–4).

The Joint United Nations Program on HIV/AIDS set a target for member states to have virtual elimination of MTCT to less than 5% and 90% reduction of new human immunodeficiency virus (HIV) infections among young children by 2015, and moved the global commitment to eliminate MTCT by 2020 and the HIV epidemic in 2030 (1). Moreover, the World Health Organization recommends the Option B+ program to prevent MTCT transmission of HIV infection. Option B+ program is the provision of universal, lifelong antiretroviral therapy (ART) for all HIV-infected individuals regardless of CD4 count and WHO clinical staging as a "Test and Treat" approach in 2016 (2, 5–7). These strategies are directly related to an increase in the coverage of antiretroviral medicines taken by pregnant women living with HIV from 51% in 2010 to 80% in 2017 to prevent MTCT (1). In addition to this, these programs contributed to the reduction of maternal mortality by 44% between 1990 and 2015 (8) and the aversion to 1.4 million new child infections since 2010 (1). Despite these efforts, loss to follow-up (LTFU) and poor adherence to drugs remain major challenges in achieving virtual elimination of MTCT of HIV, especially in sub-Saharan Africa (9). Loss to follow-up in the prevention of mother to child transmission (PMTCT) program had an impact on women's access to HIV care and treatment, which led to an advanced HIV stage, increased maternal HIV/acquired immunodeficiency syndrome (AIDS)-related morbidity and mortality, vertical transmission of HIV to newborns, development of drug resistance, and missed opportunities for family planning (2, 10). Moreover, LTFU has consequences for future pregnancies of child health and survival and increases the risk of transmission if the partner is serodiscordant (2).

Different studies have indicated that the incidence of LTFU among HIV-positive pregnant and lactating mothers in the PMTCT program varies in different countries. The incidence rates of LTFU in Brazil (11) and Myanmar (12) among mother–child pairs and pregnant women in the PMTCT program were 15.4% and 7 per 1,000 person-years, respectively. Moreover, the incidence of LTFU among pregnant and lactating mothers under the Option B+ program remains high in different African countries, ranging from 16% to 53.7% (9, 13–26). Previous studies in Ethiopia have shown that the rate of LTFU among women under the Option B+ program varies from region to region. A retrospective follow-up study at different public health facilities in the northeast regions of Ethiopia showed that the cumulative incidence of LTFU was 16.5% (27). Other findings revealed that cumulative incidence was 15.4% with an incidence rate of 9 per 1,000 person-months (PM) in western Ethiopia (28) and 18.2% in western Oromia (29).

Based on different studies, maternal age less than 25 years (9, 13, 15, 21, 26, 30, 31), lower educational status (15, 32), unmarried marital status (19), unemployment status (26), positive partner HIV status (9, 16), baseline low CD4 cell counts and high viral load measurement (33, 35), WHO clinical stage 3/4 (23), treatment on the same day of initiation as HIV diagnosis (20, 23), new enrolment in PMTCT services, drug side effects, and changes in the treatment regimen (15, 36–38) were significant predictors of LTFU.

Although there are studies on LTFU among the general adult population on ART care, there are no published studies on the incidence of LTFU and its predictors among HIV-positive pregnant and lactating mothers on ART treatment since the start of the Option B+ program. The findings of this study will help health institution managers and programmers develop evidence-based interventions to promote retention in care for both mothers and infants, because early identification of magnitude and factors helps identify vital sites and improve women with HIV by enhancing viral suppression. The findings of this study will also assist policymakers and programmers in focusing on the major identified risk factors for LTFU among HIV-positive women to improve PMTCT services and eradicate HIV as planned in 2030.

Methods

Study setting

This study was conducted at health facilities in Gondar, Northwest Ethiopia. This town is located in the Amhara region 748 km from Addis Ababa. It has one referral hospital that provides services for over 5 million people in the catchment area (39). The PMTCT program began on June 23, 2013, and since then 1,049 women with HIV were enrolled for PMTCT services and treatment through December 31, 2019.

Study design and population

This institution-based retrospective follow-up study was conducted among pregnant and lactating women in the Option B+ PMTCT program. Data were extracted from February to April 2020. Pregnant and lactating women in the PMTCT program from June 23, 2013, to December 31, 2019, were included in the study. The study included only pregnant and breastfeeding women who were enrolled in long-lasting ART PMTCT services for at least 3 months before the end of data collection. We excluded patients with incomplete PMTCT record regarding maternal cohort outcomes and data inconsistencies regarding ART confirmation and initiation in the Option B+ program. A total of 403 pregnant and breastfeeding women's charts were reviewed after selection using simple random sampling from the PMTCT register based on the inclusion criteria.

Study variables and definitions

The outcome variable in this study was the incidence of LTFU in the Option B+ PMTCT program.

Operational definitions

LTFU is defined as missing 90 days after the last documented visit as per recently developed simplified tools to measure retention in care in ART programs (40, 41). **Event:** LTFU, which is 3 months after the last documented visit under Option B+ PMTCT and not recorded as "dead," "retained," or "transferred-out" on the patient's PMTCT logbook or medical cards (4). **Censored:** A patient did not develop an event or LTFU that could be death, transferred-out, treatment completed, or receiving treatment when the study ended.

Time to LTFU: Time in months from the beginning of treatment under the Option B+ PMTCT program to LTFU under the program. **Recent adherence level:** Adherence was classified as good, fair, or poor, according to the percentage of drug dosage calculated from the monthly total dose of ART drugs. Describe as **good** (equal to or greater than 95% or ≤missing less than or equal to 2 out of 30 doses or missing 3 or less from the 60 doses), **fair** [(85%–94%) adherence or missing 3–5 doses out of 30 tabs or 3–9 tablets from 60 doses], or **poor** (less than 85% or missing ≥6 tablets out of 30 tabs or >9 tabs from 60 tabs) (42). The functional status of women was defined based on the WHO criteria as follows: **Working** is defined as the ability to perform usual work inside or outside the home. **Ambulatory**: able to perform activities of daily living. **Bedridden**: inability to perform activities of daily living (43).

Data collection procedure and quality assurance

The data sources included the Federal Ministry of Health patient card, ART intake forms, HIV care follow-up, and the PMTCT register using a data extraction checklist. The components of the checklist are sociodemographic characteristics, immunologic, treatment, clinical, behavioral, follow-up, and outcome variables. Records of patients in the last 7 years after the Option B+ program were extracted based on the inclusion criteria. Six data collectors and two supervisors were recruited to extract data from the PMTCT service records at the University of Gondar Comprehensive and Specialized Hospital. Data reviewers were trained with BSc midwives working in the PMTCT clinic. Data were extracted using a structured extraction tool prepared for the study. The data extraction checklist was prepared based on the information contained within the patient registration and follow-up cards, according to national guidelines.

Statistical analysis

After collecting the data, they were cleansed, coded, and entered into Epi Data version 4.6.0.0. They were then exported to STATA version 14 (StataCorp, College Station, TX, United States) for further analysis. The incidence rate was computed using person-month observations by adding the amount of time spent by study participants during the follow-up period. Kaplan–Meier non-parametric survival analyses were performed to estimate the cumulative survival probability of LTFU at a specific time after the PMTCT program and the Nelson–Aalen method was used to generate a cumulative hazard function. Univariate Cox proportional hazards were fitted to the predictors of LTFU among women in the Option B+ PMTCT program for complete data. Potential predictors significantly associated with LTFU in the univariate models ($p < 0.25$) were evaluated using a multivariable model. To identify the combination of factors that best predicted LTFU, the backward stepwise Cox proportional hazards model evaluated the inclusion or exclusion of potential predictors at each step. The model with the highest log likelihood was chosen and checked for individual variation using a univariate frailty model. The proportional hazard assumption and fit of the model were checked using the Schoenfeld global test and Cox-Snell residual plot, respectively. Finally, results were reported as a hazard ratio with 95% CI and examined at a significance level of $p = 0.05$ using a multivariable Cox proportional hazard model.

Results

Sociodemographic and maternal-related characteristics

The mean [± standard deviation (SD)] age of the mothers was 27.6 ± 4.7 years. Overall, 98 (24.3%) women were aged 15–24 years old. The majority of study participants 248 (61.5%) were urban dwellers. A total of 186 participants (46.1%) were housewives. Of the 403 observations, 359 (89.1%) women were pregnant during ART treatment and 169 (41.9%) were newly enrolled in ART treatment. Approximately 70 (17.4%) women had a mid-upper arm circumference (MUAC) (<23 cm) level. Overall, 222 (55.1%) of the partners were positive for HIV (**Table 1**).

Clinical, laboratory, and treatment-related characteristics

The mean ± SD of CD4 was 419.1 ± 224.0 cells/ml^3 with a CD4 count greater than 350 cells/mm^3 of 238 (59.1%) at baseline. Of the total study participants, 344 (85.4%) were classified as WHO clinical stage one followed by WHO clinical stage two 37(9.2). The combination therapy *AZT-3TC-EFV* was the second predominant regimen prescribed during enrolment for 105 (26.1%) women, followed by *TDF-3TC-EFV* for 239 (59.3%). Overall, 132 (32.8%) women were anemic during enrolment. The majority (83.6%) of the women had good adherence levels, and 72 (17.9%) developed ART treatment-related side effects during PMTCT enrolment. Overall, 279 (69.9%) women had at least one recorded viral load measurement within 3 months of PMTCT enrolment (**Table 2**).

Maternal PMTCT cohort outcome of the study

Survival status of study participants

Overall, 6.8% (95% CI: 13.5–20.8) of women were LTFU to ART treatment by completing the PMTCT program, and five (1.2%)

TABLE 1 Baseline sociodemographic, maternal-related characteristics of pregnant and breastfeeding women on Option B+ from June 2013 to December 2019 in Northwest Ethiopia (n = 403).

Variables	Category	Frequency (41)
Age in years	Mean ± SD	27.6 ± 4.7
	15–24	98 (24.3)
	25–29	160 (39.7)
	30–45	145 (36.0)
Place of residence	Urban	248 (61.5)
	Rural	155 (38.5)
Marital status	Single	53 (13.2)
	Married	264 (65.5)
	Widowed	33 (8.1)
	Divorced	53 (13.2)
Religion	Orthodox Christian	328 (81.4)
	Muslim	49 (12.2)
	Others (protestant, catholic)	26 (6.4)
Educational status	No education	126 (31.3)
	Primary	112 (27.8)
	Secondary	110 (27.3)
	Above secondary	55 (13.6)
Occupational status	Housewife	186 (46.1)
	Governmental employee	62 (15.4)
	No-governmental employee	23 (5.7)
	Daily laborer	99 (24.6)
	Others[a]	33 (8.2)
Number of pregnancies	One	147 (36.5)
	Multiple	256 (63.5)
Enrolment Status of women	Pregnancy	359 (89.1)
	Breastfeeding	44 (10.9)
Enrolment type to PMTCT	New	169 (41.9)
	On ART before enrolment	234 (58.1)
Recent MUAC level	≥23 cm	333 (82.6)
	<23 cm	70 (17.4)
Partner HIV status	Positive	222 (55.1)
	Negative	131 (32.5)
	Unknown/not done	50 (12.4)
Disclosure status	Yes	315 (78.2)
	No	88 (21.8)
Total		403 (100.0%)

[a]Others: student and merchant.

TABLE 2 Clinical, laboratory, and treatment-related characteristics of pregnant and breastfeeding women on Option B+ from June 2013 to December 2019, Northwest Ethiopia.

Variables	Category	Frequency (41)
TB screening status	Negative	379 (94.0)
	Positive	24 (6.0)
INH prophylaxis	No	351 (87.1)
	Yes	52 (12.9)
Comorbidity	Yes	27 (6.7)
	No	376 (93.3)
Initial ART regimen	*AZT-3TC-NVP*	105 (26.1)
	AZT-3TC-EFV	29 (7.2)
	TDF-3TC-EFV	239 (59.3)
	TDF-FTC-NVP	22 (5.4)
	Others	8 (2.0)
Change of ART regimen	No	344 (85.4)
	Yes	59 (14.6)
Anemia status	Not anemic	271 (67.2)
	Anemic	132 (32.8)
Adherence level	Good	337 (83.6)
	Fair/Poor	66 (16.4)
Maternal CPT	No	223 (53.3)
	Yes	180 (44.7)
Drug side effects	No	331 (82.1)
	Yes	72 (17.9)
WHO clinical stage	Early stage (I/II)	381 (94.6)
	Late stage (III/IV)	22 (5.4)
Functional status	Working	355 (88.1)
	Ambulatory/bedridden	48 (11.9)
Time of ART initiation	Later	144 (35.7)
	Same day	259 (64.3)
CD4 cell count (cells/mm^3)	Mean ± SD	419.1 ± 224.0
	Less than 200	60 (14.9)
	200–350	105 (26.1)
	Greater than 350	238 (59.1)
Baseline viral load taken	Yes	279 (69.2)
	No	124 (30.8)
Total		403 (100.0%)

CPT, co-trimoxazole preventive therapy; AZT, Zidovudine; 3TC, Lamivudine = Nevirapine; EFV, Efavirenz = Tenofovir Disoproxil Fumarate; FTC, Emtricitabine; Others, 1 g (ABC + 3TC + NVP), 2f (AZT-3TC-ATV/r), second-line treatment; TB, Tuberculosis; INH, Isoniazid; Comorbidity, heart disease and/or renal diseases and/or hypertension, and/or diabetes mellitus.

women died during ART treatment of PMTCT. About 403 study participants were followed for a mean ± SD time of 17.9 (±7.2) months. Of the total observations, 12 (2.9%), 31 (7.7%), 53 (13.2%), and 68 (16.8%) women were LTFU at the end of 6, 12, 18, and end months of the PMTCT program, respectively. Three hundred and thirty-five (83.1%) observations were censored (retained, transferred out, or died) at the end of the enrolment (Figure 1).

Incidence rate of LTFU

We calculated the incidence rate by taking the denominator as PM because the study was a dynamic cohort. During the follow-up period, a total of 7,215 person-months' time risk was observed with an overall incidence rate of LTFU 9.4/1,000 person-months (95% CI: 7.4–11.9) by the end of PMTCT follow-up. The incidence proportion of LTFU was dramatically declining from the initiation of the program in 2013 from 38% to 6.8% in 2019 (Figure 2).

The Kaplan–Meier method for the time to LTFU after ART initiation during the PMTCT follow-up period showed that close to 80% of the participants were still in care after 12 months of follow-up (Figure 3). The cumulative hazard estimate of LTFU showed a difference in the enrolment status of the PMTCT program. The cumulative hazard of LTFU among HIV-positive lactating women was higher than pregnant women during PMTCT enrolment (Figure 4).

Incidence of LTFU among different levels of predictor variables

Overall, the incidence rate was higher for women residing in rural areas (19.3 per 1,000 person-months) and lower for mothers residing in urban areas (4.1 per 1,000 person-months). The l-rank test also showed that women had a significant difference in LTFU between the rural and urban areas. Moreover,

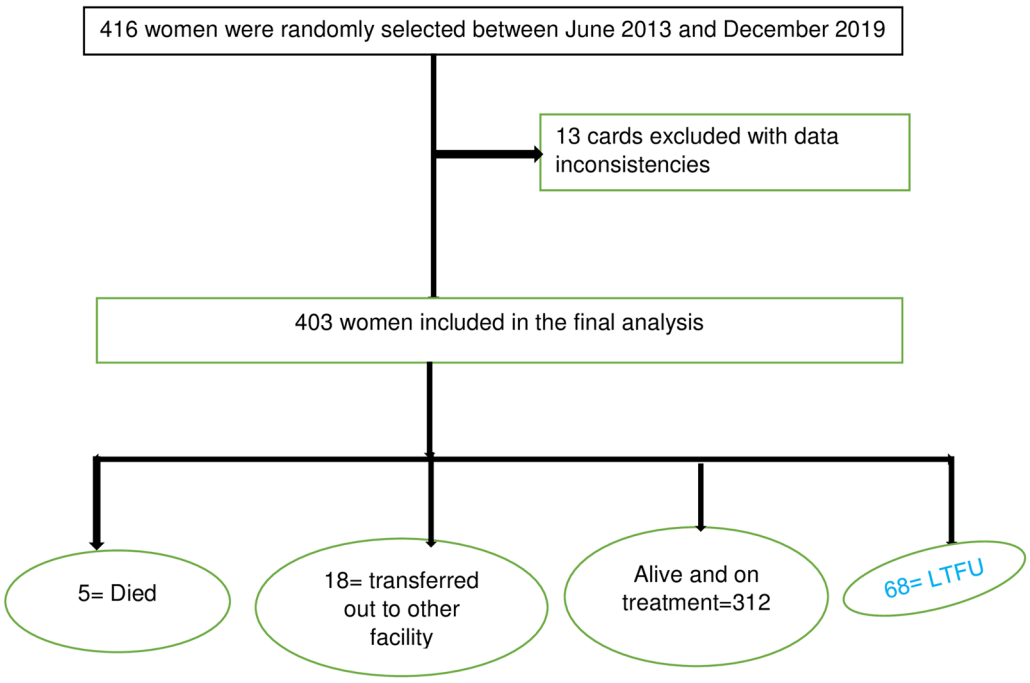

FIGURE 1
Consort diagram with total number of eligible patients and final number of women included in the analysis.

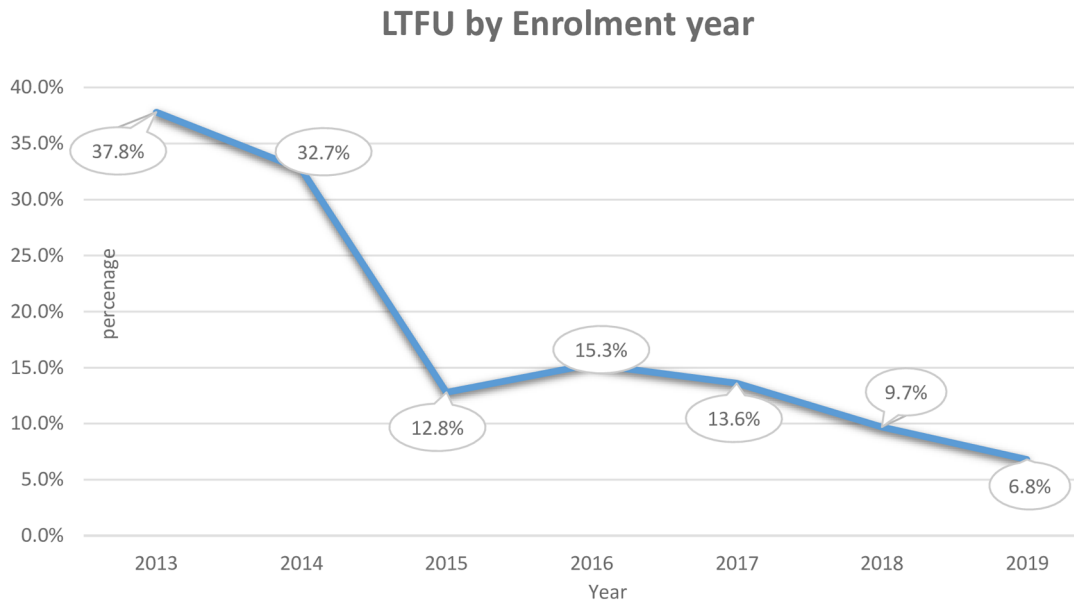

FIGURE 2
Incidence of LTFU by enrolment year among pregnant and breastfeeding women on Option B+ PMTCT program from June 2013–December 2019 in Northwest Ethiopia.

it shows that the incidence of LTFU was significantly different according to the patient's marital status, religion, status of women during enrolment, enrolment type, MUAC level, anemia status, adherence level, CD4 cell count, ART initiation time, drug side effects, and baseline viral load so that these variables were included in the binary cox regression (Table 3).

Factors affecting loss to follow-up from PMTCT service

Predictors included in the multivariable Cox regression analysis were those with a p-value <0.25 in the bivariable analysis, and 21 variables were selected in the first step of model building. After

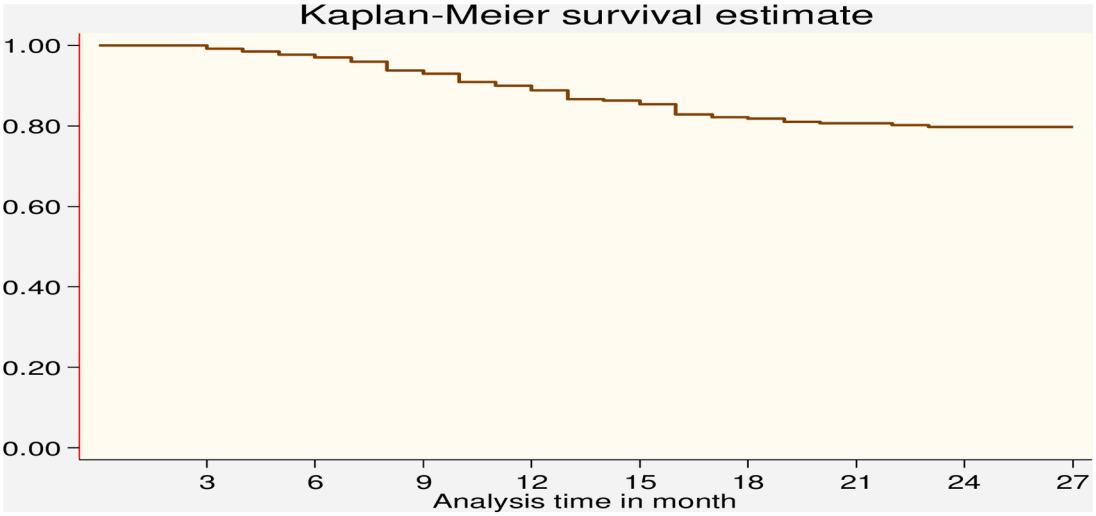

FIGURE 3
Kaplan–Meier survival estimate of LTFU among pregnant and breastfeeding women on Option B+ PMTCT program from June 2013–December 2019 in Northwest Ethiopia.

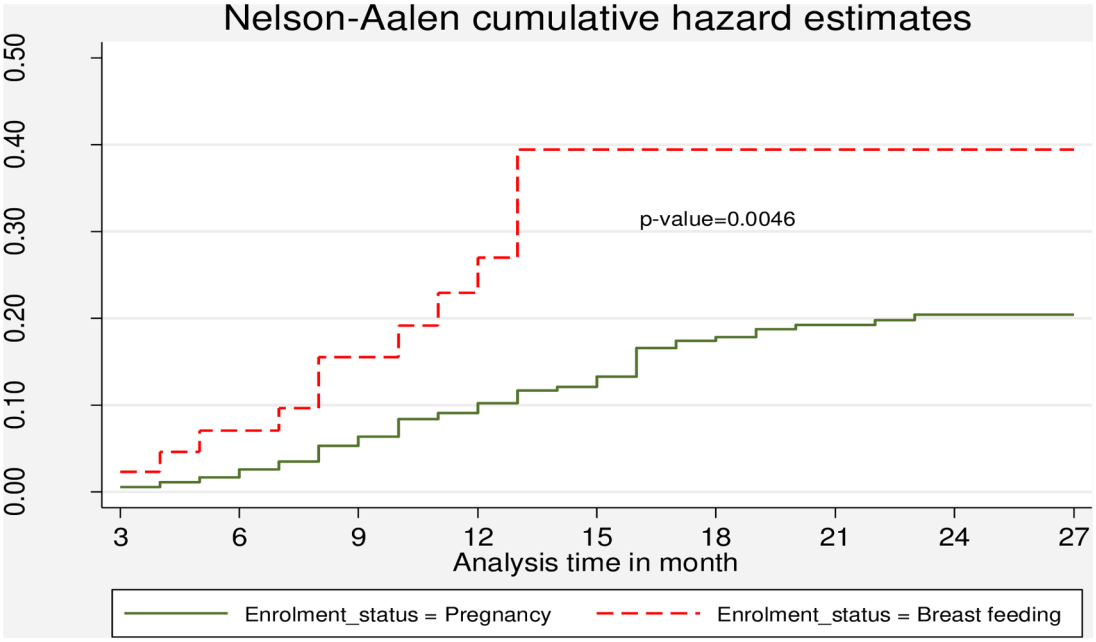

FIGURE 4
Cumulative hazard estimate of LTFU among pregnant and breastfeeding women on Option B+ PMTCT program by from June 2013–December 2019 in Northwest Ethiopia by enrolment status.

running backward stepwise variable selection and considering multicollinearity, the first group was selected as the best model from the likelihood ratio, which included full (17) variables in the multivariable analysis.

According to the multivariable Cox regression analysis, rural residents were at a 2.30 higher risk of LTFU (AHR: 2.30; 95% CI: 1.08–4.88) as compared to urban residents. Muslim religious followers were at 2.44 times higher risk of LTFU (AHR: 2.44; 95% CI: 1.23–4.81) as compared to Orthodox Christian religious followers. The risk of LTFU for participants who started ART on the same day as HIV diagnosis was 3.23 times more likely than the latter initiation (AHR: 3.23; 95% CI: 1.53–6.84). Participants who were on ART before PMTCT enrolment had a 70% increased risk of LTFU compared with newly enrolled patients (AHR: 0.30; 95% CI: 0.15–0.62). During the last PMTCT follow-up, LTFU among participants who had drug side effects was 82% higher than that among their counterparts (AHR: 1.82; 95% CI: 1.01–3.33). Participants with suboptimal adherence status (fair/

TABLE 3 Comparisons of LTFU among different levels of baseline predictor variables using a log-rank test from pregnant and breastfeeding women on Option B+ PMTCT program in Northwest Ethiopia (June 2013–December 2019).

Variables	Category	LTFU		Log-rank test	
		IR/1,000	PMO	X^2	*p*-value
Age in years	15–24	7.9	1,780		
	25–29	9.2	2,818	0.84	0.6580
	30–45	10.7	2,617		
Place of residence	Urban	4.1	4,675		
	Rural	19.3	2,540	40.98	<0.0001
Marital status	Single	21.5	838		
	Married	7.2	4,866	17.11	0.0002
	Widowed/divorced	9.9	1,511		
Religion	Orthodox Christian	7.8	6,002		
	Muslim	19.5	718	10.93	0.0042
	Others[a]	14.1	495		
Educational status	No education	13.1	2,139		
	Primary	7.3	2,057	4.26	0.2350
	Secondary	8.1	1,985		
	Above	8.7	1,034		
Employment status	Housewife	7.8	3,322		
	Government employee	9.8	1,120	5.74	0.2190
	Non-government employee	19.8	405		
	Daily laborer	9.5	1,789		
	Others[a]	10.4	579		
Number of pregnancies	Single	9.8	2,637		
	Multiple	9.2	4,578	0.11	0.7418
Partner HIV status	Positive	8.6	4,074		
	Negative	7.3	2,326	10.61	0.0050
	Unknown/not done	19.6	815		
Disclosure status	Yes	6.9	5,730		
	No	18.9	1,485	17.49	<0.0001
Enrolment status	Pregnancy	8.4	6,647		
	Breastfeeding	21.1	568	8.05	0.0046
Enrolment type	New	13.7	2,698		
	On ART before enrolment	6.8	4,517	8.44	0.0037
Comorbidity	No	8.0	6,488		
	Yes	22.2	727	13.51	0.0002
MUAC level	≥23 cm	5.6	6,203		
	<23 cm	32.6	1,012	67.16	<0.0001
Anemia status	Not anemic	4.3	5,128		
	Anemic	22.0	2,087	48.56	<0.0001
Maternal CPT	No	4.5	4,017		
	Yes	15.6	3,198	23.81	<0.0001
Initial ART regimen	*AZT-3TC-NVP*	10.3	1,933		
	AZT-3TC-EFV	5.2	582		
	TDF-3TC-EFV	10.5	4,091	4.58	0.2050
	Other	3.3	609		
WHO clinical stage	Early stage(I/II)	8.5	6,908		
	Late stage (III/IV)	29.3	307	13.06	0.0003
Functional status	Working	7.2	6,538		
	Ambulatory/ bedridden	31.0	677	37.27	<0.0001
Adherence level	Good	4.4	6,310		
	Fair/Poor	44.2	905	134.86	<0.0001
CD4 cell count in cells/ml	>350	6.0	4,340		
	200–350	7.8	1,917	14.69	0.0001
	<200	28.2	958		
ART initiation time	Same day	11.5	4,707		
	Latter	5.6	2,508	5.86	0.0155
ART side effects	No	5.1	6,104		
	Yes	33.3	1,111	79.40	<0.0001
Baseline viral load taken	Yes	3.1	5,196		
	No	25.8	2,019	79.00	<0.00001

IR, incidence rate of loss to follow-up; PMO, person-month observation. Comorbidity included chronic illness, tuberculosis, and opportunistic infections.
[a]Others: student and merchant.

poor) had a 3.96 times higher risk of LTFU (AHR: 3.96; 95% CI: 2.18–7.19) than participants with good adherence. Finally, the risk of LTFU among women who had no viral load measurement was 4.21 times higher than those who had viral load measurement during enrolment (AHR: 4.21; 95% CI: 2.23–7.96) (**Table 4**). The global test results showed $p > 0.05$; thus, we did not violate the proportional assumption.

Discussion

Loss to follow-up is a major challenge in PMTCT programs, which leads to the advanced stage of HIV, increases maternal HIV/AIDS-related morbidity and mortality, enables the vertical transmission of HIV to newborns, facilitates the development of drug resistance, and missed opportunities for family planning (40). Nationally, there is a target for fulfilling the 90-90-90 strategy as a percentage of currently receiving antiretroviral therapy among all adults and children living with HIV to be 90%, which is to decrease LTFU to less than 10% (5). Therefore, this retrospective record review was conducted to determine the incidence and predictors of LTFU among pregnant and lactating women in the Option B+ PMTCT program in Northwest Ethiopia.

The overall incidence density of LTFU in the current study was 9.4 per 1,000 person-months by the end of the PMTCT follow-up period This finding is in agreement with a previous study conducted in Nekemte Hospital, Western Ethiopia (9 per 1,000 person-months observations) (28). This is due to the similarity in study times at which nationally different strategies were adopted to increase ART coverage and adherence. Among these, ART drug refill and clinical follow-up, including laboratory investigations, were performed in advance at the ART/PMTCT clinic. In addition, case managers who are trained lay workers, most of whom are people living with human immune deficiency virus, provide adherence and psychosocial services at these ART health facilities to decrease interruption from services (44, 45). However, this finding is lower than that reported in study from Northeast Ethiopia (14.8 per 1,000 person-months observations) (27). This difference might be due to the difference in the study time that the study was initiated. The current study includes recent year data at which most strategies at a country level were implemented to decrease LTFU, such as bringing services closer to communities by expanding ART sites to above 1,500 health facilities and increasing service provision by expanding trained health personnel to decrease waiting times at the facility compared to previous studies. The variation could also be explained by the difference in

TABLE 4 Multivariable Cox regression of LTFU among pregnant and breastfeeding women on Option B+ PMTCT program from June 2013–December 2019 in Northwest Ethiopia.

Variables		Censored	LTFU	Crude hazard ratio	Adjusted hazard ratio
				CHR (95% CI)	AHR (95% CI)
Residence	Urban	229	19	1	1
	Rural	106	49	4.75 (2.79–8.07)	2.30 (1.08–4.88) *
Religion	Orthodox	281	47	1	1
	Muslim	35	14	2.52 (1.38–4.57)	2.44 (1.23–4.81)*
	Others[a]	19	7	1.84 (0.83–4.07)	2.33 (0.87–6.21)
Marital status	Married	229	35	1	1
	Single	35	18	3.12 (1.77–5.52)	1.57 (0.76–3.23)
	Divorced/widowed	71	15	1.38 (0.76–2.53)	0.77 (0.36–1.65)
Disclosure status	Yes	275	40	1	1
	No	60	28	2.67 (1.65–4.34)	0.91 (0.47–1.81)
ART initiation time	Latter	130	14	1	1
	Same day	205	54	2.02 (1.12–3.65)	3.23 (1.53–6.84)*
Comorbidity	No	307	52	1	1
	Yes	28	16	2.72 (1.55–4.77)	0.77 (0.37–1.59)
MUAC level	Greater or equal to 23 cm	298	35	1	1
	Less than 23 cm	37	33	5.78 (3.58–9.33)	1.79 (0.91–3.52)
Anemia status	Not anemic	249	22	1	1
	Anemic	86	46	5.04 (3.03–8.39)	1.78 (0.97–3.26)
Clinical stage	Early stage (I/II)	322	59	1	1
	Late stage (III/IV)	13	9	3.35 (1.66–6.78)	0.87 (0.33–2.3
Functional status	Working	308	47	1	1
	Ambulatory/bedridden	27	21	4.33 (2.58–7.26)	1.51 (0.63–3.61)
Maternal CPT	No	205	18	1	1
	Yes	130	50	3.49 (2.03–5.98)	1.84 (0.95–3.58)
Enrolment status	Pregnancy	303	56	1	1
	Breastfeeding	32	12	2.39 (1.28–4.49)	0.97 (0.95–2.25)
Enrolment type	New	132	37	1	1
	On ART before enrolment	203	31	0.50 (0.31–0.81)	0.30 (0.15–0.62)**
Side effects	No	300	31	1	1
	Yes	35	37	6.52 (4.04–10.52)	1.82 (1.01–3.33) *
ART adherence level	Good	309	28	1	1
	Fair/poor	26	40	10.19 (6.26–16.58)	3.96 (2.18–7.19)***
Baseline Viral load taken	Yes	263	16	1	1
	No	72	52	8.29 (4.73–14.52)	4.21 (2.23–7.96)***
Baseline CD4 cell count	<200	33	27	1	1
	200–350	90	15	0.28 (0.15–0.54)	1.19 (0.50–2.83)
	>350	212	26	0.22 (0.13–0.37)	1.53 (0.67–3.49)

[a]Others: protestant and Catholic religions.
*Significant at *p*-value 0.05.
**Significant at *p*-value 0.01.
***Significant at *p*-value 0.001.

the study settings, since this study was conducted at 1 referral hospital whereas a previous study was conducted in 4 hospitals and 10 health centers. Studies have shown that the magnitude of loss to follow-up varies according to the level of health institution (23, 27). Moreover, the lower incidence of LTFU in the current study might be because different programs and measures have been implemented in the country in recent years to decrease the rate of LTFU women with HIV infection. Loss to follow up will be decreased by increasing trained human power, including midwives, frequent follow-up schedules, and better drug preparation (fixed-dose ART treatment) by providing better consideration for mothers to implement the program effectively (40). It is also lower than those of studies conducted in different African countries such as Uganda (15, 16, 18), South Africa (24), Malawi (14, 46), and Kenya (19). This discrepancy might be due to the differences in study time, operational definition of the outcome variable, and characteristics of the study participants. For example, the study period in Malawi was a 3-year record review (14), whereas the current study incorporated recent years' data that had improved ART coverage. Another explanation for the discrepancy in incidence rate was the characteristics of study participants; the study in Uganda incorporated 92% of the population with a rural place of residence (16) compared to only 38.5% in the current study. The operational definitions of studies in Kenya and South Africa (26, 32) were missing 6 months until the last follow-up visit compared to 3 months in the current study. Furthermore, the rate of LTFU in the current study was lower than that in a study conducted in Myanmar, which was 7 per

1,000 person-years (11). This difference might be because the study in Myanmar included only pregnant women. Pregnancy-related symptoms and signs during antenatal care clinics (17) have a chance of dropping out from the PMTCT clinic (47).

The current study showed that the risk of LTFU among women residing in rural areas was higher than that among women residing in urban areas. Supporting findings have been reported in previous studies in Ethiopia and Brazil (10, 28, 48). Possible explanations for this might be that mothers from remote areas are forced to travel long distances to get to the nearest hospital, which necessarily involves high costs that lead to LTFU (16), and cannot easily get transport services due to poor/lack of road construction, making women walk long distances barefoot, which leads them to be less likely to adhere to Option B+ strategy (29), resulting in missing appointments (15, 31). This justification is also supported by the report that lack of access to healthcare services leads to poor adherence and LTFU to Option B+ PMTCT drugs (15). Although this was not assessed in the current study, an additional explanation for the high risk of LTFU is that, in a rural setting, transport is costly because most mothers are farmers and housewives with low socioeconomic status (16).

This study also found that women who had no baseline viral load measurements were more likely to have LTFU than those who had baseline viral load measurement within 3 months of PMTCT enrollment. This finding is supported by a study in Nigeria among the general population, missing viral load measurements increasing LTFU (49). This might be because when viral load measurements were taken during PMTCT enrolment, the healthcare provider classified women as high risk with a viral load of more than 1,000 copies/mm^3 and low risk with a viral load of less than 1,000 copies/mm^3. Therefore, those in high-risk categories will be followed carefully and frequently in order not to miss the appointment time since it is a gold criterion to know the women in a good way or adhere to service provisions (40). Another possible explanation for the high rate of LTFU in those who had no baseline viral load measurement is that viral load measurement was implemented in advance after 2016 in Ethiopia. Another possible explanation could be that taking viral load measurement at baseline raises women's HIV-related literacy and awareness and might engage women in care (45).

Moreover, women with fair/poor drug adherence were more likely to have LTFU than women with good adherence. This finding is supported by studies conducted in Ethiopia (48) and Malawi (22). This might be because poor adherence to drugs is due to the feared side effects resulting in stopping taking ART treatments and lack of knowledge toward the importance of adherence to all appointments lead to stopping/missing the schedule of ART treatment (18).

The current study revealed that the risk of LTFU in women who started ART on the same day following HIV diagnosis was higher than that in women who started ART later following HIV diagnosis. This finding agrees with those of studies conducted in Northeast Ethiopia (27) and Malawi (20). This might be due to the need for sufficient time and information for clients to adjust and prepare themselves for lifetime treatment, psychologically, socially, and physically. Moreover, the reason for loss to follow-up for those women who started the same-day initiation might be due to the combined effect of ART side effects at the time of initiation and pregnancy-induced physiological side effects, such as regurgitation, nausea, and vomiting, which leads to loss in treatment follow-up. However, a study in southern Ethiopia suggested that pregnant women who started ART at the time of HIV diagnosis were more likely to adhere to Option B+ ART, resulting in increased retention in HIV care (29), which is contrary to the findings of this study. The current study is also against the study in South Africa, which showed that same-day antiretroviral therapy initiation in pregnancy is not associated with engagement in care (35). This might be due to the difference in study participants, in which the study in South Africa included only pregnant women.

The risk of LTFU among women who were receiving ART before PMTCT enrolment was lower than that among women who were enrolled in PMTCT. This finding is in agreement with studies conducted in different countries in Africa (19, 23, 28). A possible explanation for this might be that a known HIV woman on ART before enrolment had experienced ART treatment and might have good awareness about ART treatment, drug side effects, and drug adherence than a newly enrolled woman. Evidence also showed that a new HIV diagnosis during routine antenatal screening can be attended by different degrees of shock and denial and may lead to difficulty accepting immediate initiation of lifelong treatment, resulting in a loss to follow-up (46). This study also supported a previous study done in South Africa, which stated that being newly diagnosed with HIV was a positively significant predictor of disengagement from ART treatment (24).

The findings of the current study also revealed that women who had ART side effects during PMTCT follow-up had a higher risk of LTFU than those who had no ART side effects. The findings of this study are supported by studies in Uganda (16) and Malawi (9, 26, 36). This might be due to less counseling on the side effects of ART and less support for women experiencing challenges with tolerability, including options to switch regimens (24).

All in all, the incidence rate of LTFU was higher in the last month of the PMTCT follow-up period, implying a lack of proper linkage and referral systems between PMTCT services and ART clinics. In addition, contrary to the current study, variables such as educational status, maternal age, and baseline CD4 cell count showed statistically significant associations with LTFU among HIV-infected women receiving PMTCT services in previous studies conducted in different African countries (15, 23, 24, 26, 27, 36). However, these variables were not statistically significant in this study. This difference might be because the predictors of LTFU varied from one geographical area to another due to the differences in the economic status of the study participants and infrastructure in the health facilities.

Limitations of the study

This study has some limitations that must be considered before interpreting the results. First, as we conducted a thorough review of records, we did not include important predictors of LTFU such as stigma, distance to hospital, and social support. Second, the true

incidence of LTFU might have been underestimated and/or overestimated because of incomplete documentation of data and classification errors. Finally, there are limitations related to the abstraction of routinely collected data.

Conclusion

The current study revealed that the incidence of LTFU dramatically and consistently decreased as Option B+ matured from 38% in 2013 to 6% in 2019. A high rate of LTFU was observed in the last month of PMTCT follow-up. The study also found a lower rate of LTFU among HIV-positive women than in previous studies, but it was slightly higher than the WHO target. The place of residence, recent adherence level, baseline viral load measurement, known HIV status, time of ART initiation, drug side effects, and religion were found to be predictors of LTFU. We recommend that the hospital pay more attention to rural dwellers to decrease LTFU in collaboration with the Zonal Health Department, the Woreda Health Office, and stakeholders. Information about optimal ART drug adherence and viral load measurement is recommended because these are the main contributing factors to the decline in LTFU over time. Better consideration should be given to ART side effects that are in adherence and retention. We have recommended research on primary data that incorporates maternal conditions, community, behavioral, and cultural factors such as women's attitudes toward maternal ART treatment using qualitative studies. Moreover, it is better to be done as a prospective and prognostic model for the risk prediction of LTFU. The results of this study will help achieve the goal of the Joint United Nations Program on HIV/AIDS, which is to reduce mother-to-child transmission of HIV by 5%.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical clearance was obtained from the Ethical Committee of the Institute of Public Health at University of Gondar. First a formal letter was written from the University of Gondar to Gondar Comprehensive and Specialized Hospital. Moreover, permission for data collection was granted from the hospital. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

MA, AB, and MY developed the proposal and participated in data collection supervision, entry, and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Geospatial variations and determinants of contraceptive utilization among married reproductive age women in Ethiopia: spatial and multilevel analysis of Ethiopian Demographic and Health Survey, 2019

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Introduction: Contraception is the most effective method of preventing unwanted pregnancies and their associated disadvantages. It is critical to recognize one's desire to utilize contraceptives before drafting and implementing a good family planning program, especially in developing nations like Ethiopia.

Objective: This study aimed to identify the geospatial variations and determinants affecting the utilization of contraceptives among married reproductive age women in Ethiopia.

Method: This study was based on an extensive national survey, the Ethiopian Demographic and Health Survey. A total weighted sample of 5,743 married reproductive-age women was included. Because of the hierarchical nature of the DHS data, a spatial analysis multilevel logistic regression model was used to study individual and community-level factors that may influence contraceptives. The Bernoulli model was used by applying Kulldorff methods using the SaTScan software to analyze the purely spatial clusters of contraceptive usage. ArcGIS version 10.3 was used to visualize the distribution of contraceptives. A 95% confidence interval and a *p*-value of less than 0.05 were used to declare statistical significance.

Result: The overall utilization of contraceptives was discovered at 41.25% (39.98, 42.53). Participants age range of 25–34 years [AOR = 0.80, CI: (0.66, 0.96,)] and 35–49 years [AOR = 0.50, CI 95%:(0.66, 0.96)] times less likely to use contraceptives than 15–24 years old respectively. Having primary [AOR = 1.47, CI 95%: (1.25, 1.73)], secondary [AOR = 1.42, CI 95%: (1.09, 1.83)] and higher education level [AOR = 1.92, CI 95%: (1.41, 2.60)], middle wealth [AOR = 1.48, CI 95%: (1.14, 1.90)], richer [AOR = 1.41, CI 95%: (1.07, 1.86)] and richest [AOR = 2.17, CI 95%: (1.52, 3.11)], having 1–4 ANC follow up have [AOR = 1.60, CI 95%: (1.26, 2.03)], gave birth at age of 35–44 [AOR = 0.29, CI 95%: (0.22, 0.37)], having 3–5 children [AOR = 1.26, CI 95%: (1.03, 1.52)], being from community of high level women education [AOR = 1.61, CI

95%: (1.21, 2.15)] were associated positively. Participants from Amhara, Oromia, Benishangul and SNNPR regions have revealed [AOR = 2.40, CI 95%: (1.53, 3.77)], [AOR = 1.64, CI 95%: (1.05, 2.56)], [AOR = 1.62, CI 95%: (1.01, 2.62)] and [AOR = 2.04, CI 95: (1.31, 3.19)], in contrast, Somali and Afar regions have shown [AOR = 011, CI 95%: (0.05, 0.22)] and [AOR = 0.31, CI 95%: (0.18, 0.54)] times less likely to use contraceptive services than Tigray Region respectively. The spatial analysis of contraceptive usage discovered that the northern, central and southern parts of the country had higher utilization of contraceptives than the eastern and northeastern of the country.

Conclusion: The study revealed that contraceptive usage among married women is comparatively low, with wide regional variation. Raising awareness among mothers about the importance of antenatal care and assisting mothers who are financially disadvantaged or do not have access to health facilities will aid in providing better family planning services. Improving contraceptive information dissemination at community and regional levels is key to averting potential barriers.

KEYWORDS

multilevel analysis, spatial distributions, contraceptive, Ethiopia, married women

Introduction

Family planning (FP) and contraception is a procedure that mainly requires a discussion of agreement between a woman and a man. A trained FP service provider focuses on family health and the couple's desires to either limit or space their children (1) Contraception methods play a significant role in reducing the complication of child and maternal morbidity and mortality by unintended preventive pregnancies, including social costs (2, 3). This concept is also supported by the sustainable development goal (SDG) that emphasizes securing healthy lives and advocating well-being for everybody of all ages (3–5). Among the 1.9 billion Women of the Reproductive Age group (15–49 years) worldwide in 2019, 1.1 billion require family planning; of these, 842 million are using contraceptive methods, and 270 million have an unmet need for contraception (6, 7). Another report by the world health organization (WHO), 2017, estimated that there were 214 and 23 million reproductive-age women with the unmet need to use contraception methods and unintended pregnancies due to low-quality service, cultural opposition, and limited access and experience of side effects (8). The United Nations report shows that contraception use among women has been increasing in all world regions; however, sub-Saharan Africa is in the lower range (9). The utilization of contraceptive methods among women 15–49 years in middle and low-income countries reached 55% in 37 countries; however, below 20% in 23 countries, including Ethiopia in 2019 (10). Reports indicated that modern contraception methods prevented about 308 million unintended pregnancies, and 67 million unintended pregnancies could also be averted if the unmeet issue was solved (11).

Various studies have been investigating contributing factors of contraceptive use in sub-Saharan countries. These include poor quality of service and long distances between the health facilities and users' home (12–14). Studies also found that many individual and community level factors, such as age, marital status, religion, household wealth index, joint contraception decision, place of residence, employment status, community education level, and the number of children are associated with contraceptive use in various countries (13, 15–20). Women's knowledge, perception, and information exposure/reading newsletters and listening to the radio about contraceptive advantages were also associated factors (13, 18, 20, 21).

Pieces of evidence from the Ethiopian Demographic and Health Survey 2011 and 2016 (EDHS) depicted that factors such as educational attainment, number of living children, exposure to mass media, employment status, positive attitudes, and information about contraceptive methods were factors associated positively with contraceptive methods (22–24). However, older age, residence type, religion, regions of Afar, and Somali are associated negatively with contraceptive use (22, 24, 25). From this one can notice that there is a variation of modern contraceptive utilization in Ethiopia based on their regions, residences and other community and individual level factors. We will assess this variation for further validation.

According to several studies and analyses, investing in sexual and reproductive health in the geographical context remains a top policy priority, and joint investments in contraceptive, maternal and child health would help to address the problem (26–28). The Ethiopian federal ministry of health office created a strategy in 2015 to increase the use of contraceptives from 42% to 55% from 2016 to 2020 as part of the overall health sector transformation plan by the end of 2020 (29). The prevalence of contraceptive methods used in Ethiopia varies significantly from region to region, time to time and from study to study. For instance, data collected in 2011 and 2016 in EDHS shows the prevalence of contraceptive method utilization is 29.2% and 44.11%, respectively (22, 30). This data shows an escalation of contraceptive method use from 2011 to 2016 in Ethiopia. A systematic review study reports that long-acting and permanent contraceptive methods pooled prevalence among married women was 16.64% (31). On the other hand, a community-based survey conducted in Amhara region zonal towns showed that the overall majority of the modern contraceptive method was 38.9% (32); in western Ethiopia at Wolaita Soda and Ariba Minch towns, the prevalence was 70% and 63.4% respectively (24, 33), Oromia Region 18.2% (34), in Axum town 48.0% (35). The investigations

mentioned above had concluded different overall prevalence rates; hence they are limited to a specified study area. The prevalence results of the studies mentioned above on modern contraceptive methods in different places and times in Ethiopia show similar findings, some of which are entirely different. It was found to be EDHS that could give us general information about the country to reconcile this contradiction, so it was necessary to analyze further the EDHS of 2019.

Despite this, the majority of studies in the country focused on contraception use, side effects, and socioeconomic variables. There was limited up-to-date information available in the country about the distribution of contraceptive techniques and their spatial mapping. To further the understanding of policy-makers and program planners, it is envisaged that current research on the state of contraceptive usage, unmet demand among married women, and the factors at individual and community levels would be crucial. The information would indeed guide the development of appropriate initiatives and programs to bridge the gaps in Ethiopia's women's underuse of contraceptive methods. In turn, this will make it possible for the nation to guarantee the accomplishment of Sustainable Development Goal three, which calls for ensuring that everyone has access to contraception and other sexual and reproductive health care. As a result, research that used contraceptive methods as an objective was only able to provide a general picture of where planning and policy decisions should be made. As a result, large-scale research that depicts contraception utilization status could give a useful piece of information for planning and policy decisions. As a result, the current study employed data from the EDHS 2019 to identify geospatial variations and determinants affecting the utilization of contraceptives among married reproductive age women in Ethiopia.

Methods and materials

Study design, period, and setting

A community-based cross-sectional study was employed in Ethiopia from March to June 2019 (36). Ethiopia is a country in the Horn of Africa found in East Africa (3°–14° N and 33°–48° E) with nine regional states [Afar, Amhara, Benishangul-Gumuz, Gambella, Harari, Oromia, Somali, Southern Nations, Nationalities, and People's Region (SNNP) and Tigray] and two city administrations (Addis Ababa and Dire Dawa). It has 68 zones, 817 districts, and 16,253 kebeles (the lowest administrative units of a country). It has a population of over 110 million. Of which, 39.81% of the people are less than 14 years with a 1:1 sex ratio to the general population. The country also has a death rate of 5.8/1,000, 22.2% of urbanization, with a very high degree of major infectious diseases (37, 38). This study used the recent Ethiopian Demographic and Health Survey 2019 (EDHS 2019) to determine the spatial distribution and determinants of modern contraceptive methods in Ethiopia. The Demographic and Health Survey (DHS) captures data on various aspects of women's health and well-being, including issues of interpersonal violence. The survey is a nationally representative study, with a weighted representative sample of 5,743 women aged 15–49. We retrieved the data for this study from the EDHS website www.dhsprogram.com after the request to access the approved and downloading allowed. Then 5,743 reproductive age (15–49 years) women who are married were pooled from the EDHS 2019 to conduct the utilization of contraceptives with geospatial variation analysis.

Study population and sampling techniques

The EDHS sample was stratified and selected in two stages. Each region was stratified into urban and rural areas, yielding 21 sampling strata. In two stages, samples of Enumeration Areas (EAs) were selected independently in each stratum. Implicit stratification and proportional allocation were achieved at each lower administrative level by sorting the sampling frame within each sampling stratum before sample selection, according to administrative units at different levels, and using a probability proportional to size selection at the first stage of sampling.

In the first stage, 305 EAs (93 in urban areas and 212 in rural areas) were selected with probability proportional to EA size and independent selection in each sampling stratum. A household listing operation was carried out in all selected EAs from January through April 2019. The resulting lists of households served as a sampling frame for selecting households in the second stage. Some of the selected EAs for the 2019 Ethiopian Demographic and Health Survey (EDHS) were large, with more than 300 households. To minimize the task of household listing, each large EA selected for the 2019 EDHS was segmented. Only one segment was selected for the survey, with probability proportional to the segment size. Household listing was conducted only in the selected segment; that is, a 2019 EDHS cluster is either an EA or a component of an EA. In the second stage of selection, a fixed number of 30 households per cluster were selected with an equal probability of systematic selection from the newly created household listing (36).

Data collection procedure, analysis and variables

The study was conducted based on EDHSs data by accessing the DHS program official database www.measuredhs.com after permission was received through an online request explaining the study's objective. The outcome variable with significant predictors was extracted from Ethiopia's Demographic and Health Surveys household data set. Data were extracted using STATA version 14.1, and Microsoft Excel was applied to prepare for the spatial analysis, and to compute the community-level factors. The final model of multivariable two-level mixed-effect logistic regression analysis included categorical variables with a *p*-value of less than 0.25 in bivariate two-level mixed-effect logistic regression analysis, where odds ratios with 95% confidence intervals were estimated to identify independent variables of modern contraceptive use. *p* values less than 0.05

were used to define statistical significance. The fixed and random effects were computed to examine individual and cluster variability. In addition, comprehensive information about the community and individual characteristics was provided. Model zero (the null model) which consists of only the outcome variable without any individual and community level factors, Model, I (a model with only individual-level variables), Model II (model with only community level factors), and Model III (a model with both the individual and community level factors) are the four models presented in this investigation respectively. Women were interviewed using questionnaires based on the DHS Program's standard questionnaires that were adapted to reflect the population and health issues relevant to Ethiopia, and several data from women were obtained. Socioeconomic and demographic information was also collected from women and households. Intention to use modern contraceptive methods among women of 15–49 age was used as a dependent variable. The independent variables were age, level of education, residence, wealth status, occupation, family size, exposure to media, sex, and region.

Spatial analysis

Traditional regressions can be used to analyze data when the subjects in a study have a linear connection with the dependent variable. Put another way, the assumption of linearity is rarely met when data is structured, grouped, or hierarchical. Individual and community-level clusters differed in our scenario (hierarchies). We assumed multilevel logistic regression to account for variations because of the hierarchical nature of the data and inter-cluster variation. The differences within and across communities are considered in our research. Intra-community Correlation (ICC) was calculated using a community-level variation to determine the community effect. Following that, the model's fitness was evaluated using the Likelihood Ratio (LR) test, Median Odds Ratio (MOR), and Proportional Change in Variance (p We cross-tabulated the weighted frequency of dependent variables and cluster numbers to obtain the case to total proportion ratio to prepare data for spatial analysis (ArcGis). The data was then integrated with the results. We cleaned and eliminated data with zero Latitude/Longitude coordinates, and then used ArcGIS 10.7 to do spatial studies to see if the data pattern was concentrated, distributed, or random over the research area.

Moran analysis

The spatial autocorrelation (Global Moran's I) was used to determine if patterns of use of contraceptive techniques in the study area are scattered, clustered, or random. Moran's, I output ranges from (−1) to (+1). Values close to −1 suggested a dispersed intention to use contraceptives, but values close to +1 indicated a clustered and distributed random inclination to use contraceptives.

Hot spot analysis (Getis-Ord Gi* statistic)

The Getis-OrdGi* statistics were generated to see how the geographical autocorrelation of contraceptive method intention varies across Ethiopia. Hotspot analysis generates a Zscore and a p-value that instantly pinpoints the statistical significance of the clustering of the target variable across the study area at various significance levels. A "hotspot" (high intention to use contraceptive techniques) is indicated by a statistical output with a high GI*, while a "cold spot" is characterized by a statistical output with a low GI* (low intention to use contraceptive methods).

Spatial interpolation

Because they incorporate spatial autocorrelation and statistically optimize the weight, ordinary Kriging and empirical Bayesian Kriging were used in this study. The usual Kriging spatial interpolation strategy was used to predict the intention to use contraceptive procedures in unobserved areas of the country.

SaTscan statistics

For the local cluster detection, SaTScan Version 9.6 software was employed. A circular window that sweeps systematically throughout the study area was employed to find a substantial SaTScan clustering of contraceptive method intention. ArcGIS and SaTscan use comparable data preparation procedures, with the exception that SaTscan uses yes and no instead of proportion. Using relative risk (RR) and log-likelihood (LL), we presented the findings of major and secondary observed clusters.

Study variables

Dependent variable

Current contraceptive use among married women of reproductive age is the dependent variable. It was defined as The Demographic and Health Survey defined the current use of modern contraceptive methods among married women as including male and female sterilization, intramuscular injections, intrauterine contraceptive devices (IUCD), contraceptive pills, implants, male condoms, lactational amenorrhea, and emergency contraception (39, 40). Women were divided into "users" and "non-users," with "users" denoting those who used any contemporary contraceptive method and "non-users" representing those who did not use any contraceptive method or used Folkloric and Traditional methods.

Independent variables

The independent factors for contraceptive use were chosen based on previous research and the variable's availability in the 2019 EDHS dataset. Individual and community-level variables were aligned for a multilevel analytic method, and variables were

broadly divided into two groups. Variables at the individual level Individual-level variables included women's age at the time of the survey, educational level, household wealth index, the total number of children born, exposure to mass media, experience antenatal care follow-up during pregnancy, health facility visits, place of delivery, region, residence, women community-level poverty, and education were included.

Community-level variables

The remaining variables are not accessible directly from EDHS, although the region and place of residence were considered community-level variables. As a result, we aggregated the variables at the community level based on individual data and then categorized the aggregated values as low or high if the mean values or cluster proportions were below or above the national average, respectively. Community-level women's education and community-level women's wealth status were all considered community-level variables as a result of this.

Result

Individual-level characteristics of study participants

A total of 5,743 weighted samples of married participants were enrolled in the current study. In the age group, 2,381 (41.45) participants were under 25–34 years old. In this study, nearly half, 2,979 (51.87), 2,203 (38.37), and 1,225 (21.34), were uneducated, orthodox in religion, and most affluent in wealth status, respectively. Most of the 5,578 (97.14) and 5,523 (96.18) have checked their baby at health facilities and know contraceptive methods, respectively, whereas nearly half of the 3,514 (61.19%) and 2,817 (49.06%) have given birth at the age of 10–19 years and follow more than four times of antenatal care follow up respectively (**Table 1**).

Community-level factors and characteristics of study participants

The majority, 4,174 (72.69%) of the participants, were from rural residencies. At the same time, 2,240 (39.01%), 2,834 (49.35%), and 2,579 (44.91%) of the participants were from the Oromia region, a community with low education level and low community female wealth status, respectively (**Table 2**).

Spatial distributions and hot spot analysis of contraceptive utilization

This study depicted that the spatial distribution of contraceptive utilization was spatially clustered in Ethiopia with Global Moran's I 0.148 ($p < 0.001$). A cluster of high usage was observed. The outputs were automatically generated keys on each panel's right and left sides, respectively. Given the z-score of 3.28, there is less than a 1% likelihood that this clustered pattern could result from chance. The bright red and blue colours of the end tails indicate an increased significance level (**Figure 1**).

Spatial clustering of contraceptive utilization was found at regional levels. Of 5,743 households interviewed in 2019, only 2,369 (41.26%) had received contraceptives. The highest health insurance coverage was spatially clustered in Amhara, Tigray, Oromia, and SNNPR regions. In contrast, Somali, Afar, and Dire Dawa regions had the lowest contraceptive employment (**Figures 2**, **3**).

Ordinary Kriging interpolation

The highest prevalence of contraceptives was found in Amhara, SNNPR, Tigray, Addis Ababa, Benishangul, and areas of Oromia and Harari, according to geostatistical analysis. Ordinary Kriging interpolation calculates the distance between a known location and unknown areas to determine the facts in the event occurrence ranges. The measurements revealed a significant (**Figure 4**) site where the event could occur (prediction).

SaTscan statistics

EDHS 2019 revealed one significant local cluster area on the primary SaTscan window cluster. A total of 153 locations [coordinates/radius (8.944357 N, 35.279628 E)/468.49 km] with RR of 1.72 and LL of 106.73 was found in the primary SaTscan window cluster. The regions included were Amhara, Benishangul, Addis Ababa, Gambella, and SNNPR, with very few parts of the region (**Table 3**, **Figure 5**).

Random effect analysis and model comparison

In the first model (null model), the ICC showed that individual differences accounted for the remaining unexplained 72.33 percent of the overall variability for contraceptives, while variations between clusters/EA accounted for about 27.67 percent of that variability. Additionally, the median odds ratio showed that there was variation in the use of contraception among clusters. It was 2.87 in the null model, meaning that if women were randomly chosen from two distinct clusters, those with a higher probability of using contraceptives had a 2.87 times greater chance of doing so than those with a lower probability (EAs). The whole model described roughly 63.41 percent of the variation in contraceptives in terms of PCV. One IV was also chosen as the model that fit the user the best (which had the lowest deviance) (**Table 4**).

Factors associated with contraceptive utilization

After adjusting the possible confounders, plenty of important determinant variables were statistically significant for the utilization of contraceptive methods at the individual and community levels.

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TABLE 1 Sociodemographic and other individual characteristics of married women in Ethiopia ($n = 5,743$).

Variables		Contraceptive current utilization		Total, *n* (%)
		No, *n* (%)	Yes, *n* (%)	
Age				
15–24		733 (53.18)	645 (46.82)	1,378 (23.99)
25–34		1,278 (53.67)	1,103 (46.33)	2,381 (41.45)
35–49		1,363 (68.69)	621 (31.31)	1,985 (34.56)
Religion				
Orthodox		1,146 (52.01)	1,057 (47.99)	2,203 (38.37)
Catholic		10 (34.42)	20 (65.58)	30 (0.53)
Protestant		840 (52.49)	760 (47.51)	1,600 (27.87)
Muslim		1,328 (72.36)	507 (27.64)	1,835 (31.96)
Traditional		42 (67.48)	20 (32.52)	62 (1.09)
Others		7 (63.63)	4 (36.37)	11 (0.19)
Highest educational level				
No-formal education		2,016 (67.66)	963 (32.34)	2,979 (51.87)
Primary		1,064 (51.19)	1,014 (48.81)	2,078 (36.19)
Secondary		195 (42.94)	258 (57.06)	453 (7.89)
Higher		100 (42.78)	133 (57.22)	233 (4.05)
The current age of a child				
0–2 years		1,423 (54.00)	1,213 (46.00)	2,636 (46.39)
More than two years		1,907 (62.59)	1,139 (37.41)	3,046 (53.61)
Household wealth Index				
Poorest		772 (73.15)	283 (25.85)	1,056 (18.38)
Poorer		723 (64.43)	399 (35.57)	1,122 (19.54)
Middle		618 (54.33)	519 (45.67)	1,137 (19.79)
Richer		674 (56.05)	529 (43.96)	1,203 (20.95)
Richest		586 (47.86)	639 (52.14)	1,225 (21.34)
Knowledge of any method				
No		219 (100)	0 (0.00)	219 (3.82)
Yes		3,154 (57.10)	2,369 (42.90)	5,523 (96.18)
Place baby first checked				
Home		69 (41.89)	95 (58.11)	164 (2.86)
Health facilities		3,305 (59.24)	2,273 (40.76)	5,578 (97.14)
Place of delivery				
Home		1,089 (62.60)	650 (37.40)	1,739 (30.28)
Health facility		2,285 (57.07)	1,719 (42.93)	4,004 (69.72)
Does the household have a				
Television	No	2,855 (60.60)	1,857 (39.40)	4,712 (82.92)
	Yes	475 (48.95)	496 (51.05)	971 (17.08)
Radio	No	2,456 (60.74)	1,587 (39.26)	4,043 (71.15)
	Yes	874 (53.35)	765 (46.65)	1,639 (28.85)
Telephone	No	3,281 (58.68)	2,310 (41.32)	5,591 (98.39)
	Yes	49 (54.11)	42 (45.89)	91 (1.61)
Number of ANC follow up				
No ANC follow up		660 (71.61)	262 (28.39)	922 (16.06)
1–4 ANC follow up		998 (49.85)	1,005 (50.15)	2,003 (34.88)
More than four follow up		1,714 (60.86)	1,103 (39.14)	2,817 (49.06)
Age of respondent at first birth				
10–19		2,014 (57.30)	1,500 (42.70)	3,514 (61.19)
20–34		907 (55.77)	719 (44.23)	1,626 (28.31)
35–44		453 (75.16)	149 (24.84)	602 (10.49)
Number of total children				
0–2		1,210 (52.50)	1,095 (47.50)	2,305 (40.13)
3–5		1,044 (55.94)	822 (44.06)	1,866 (32.49)
6 and above		1,120 (71.22)	452 (28.78)	1,572 (27.38)
Number of health facility visits				
1–2		3,071 (58.44)	2,184 (41.56)	5,255 (91.50)
3–5		303 (61.98)	185 (38.02)	488 (8.50)

(*Continued*)

TABLE 1 Continued

Participants whose age group was from 24 to 34 and 35–49 years old were [AOR = 0.80, CI: (0.66, 0.96)] and [AOR = 0.50, CI 95%: (0.66, 0.96)] times less likely to utilization contraceptive methods compared to mothers from 15 to 24 years old age respectively. Similarly, household wealth status and educational level were positively associated with contraceptive methods. Participants had primary [AOR = 1.47, CI 95%: (1.25, 1.73)], secondary [AOR = 1.42, CI 95%: (1.09, 1.83)] and higher [AOR = 1.92, CI 95%: (1.41, 2.60)] times more likelihood of positive tendency to utilize contraceptive than participants with no education respectively. Regarding wealth status in the same fashion, participants in the class of, middle have shown [AOR = 1.48, CI 95%: (1.14, 1.90)], richer [AOR = 1.41, CI 95%: (1.07, 1.86)] and richest [AOR = 2.17, CI 95%: (1.52, 3.11)] times more positive association than the poorest one respectively. Those mothers having 1–4 times antenatal care follow up during their pregnancy have [AOR = 1.60, CI 95%: (1.26, 2.03)] times to use contraceptives than did not have antenatal care follow up during their pregnancy period. On the other hand, mothers who have given their first birth at the age of 35–44 years old have

TABLE 2 Community-level variables: descriptive result of contraceptive utilization among married women among contraceptive user women in Ethiopia ($n = 5,743$).

Variables	Contraceptive current utilization		Total, *n* (%)
	No, *n* (%)	Yes, *n* (%)	
Place of residence			
Urban	804 (51.24)	765 (48.76)	1,569 (27.31)
Rural	2,570 (61.56)	1,604 (38.44)	4,174 (72.69)
Region			
Tigray	224 (62.84)	133 (37.16)	357 (6.21)
Afar	56 (87.22)	8 (12.78)	64 (1.11)
Amhara	661 (50.81)	640 (49.19)	1,301 (22.66)
Oromia	1,335 (59.62)	905 (40.38)	2,240 (39.01)
Somali	271 (96.59)	10 (3.41)	281 (4.89)
Benishangul	40 (60.99)	26 (39.01)	66 (1.15)
SNMP	637 (54.79)	525 (45.21)	1,162 (20.23)
Gambela	16 (66.10)	8 (33.90)	24 (0.42)
Harari	11 (67.78)	5 (32.22)	16 (0.28)
Addis Ababa	98 (49.58)	99 (50.42)	197 (3.43)
Dire Dawa	24 (70.05)	11 (29.95)	35 (0.60)
Community-level women's education			
Low	1,898 (66.83)	936 (33.17)	2,834 (49.35)
High	1,459 (50.33)	1,450 (49.67)	2,909 (50.65)
Community-level women's wealth status			
Low	1,742 (67.55)	837 (32.45)	2,579 (44.91)
High	1,615 (51.04)	1,549 (48.96)	3,164 (55.01)

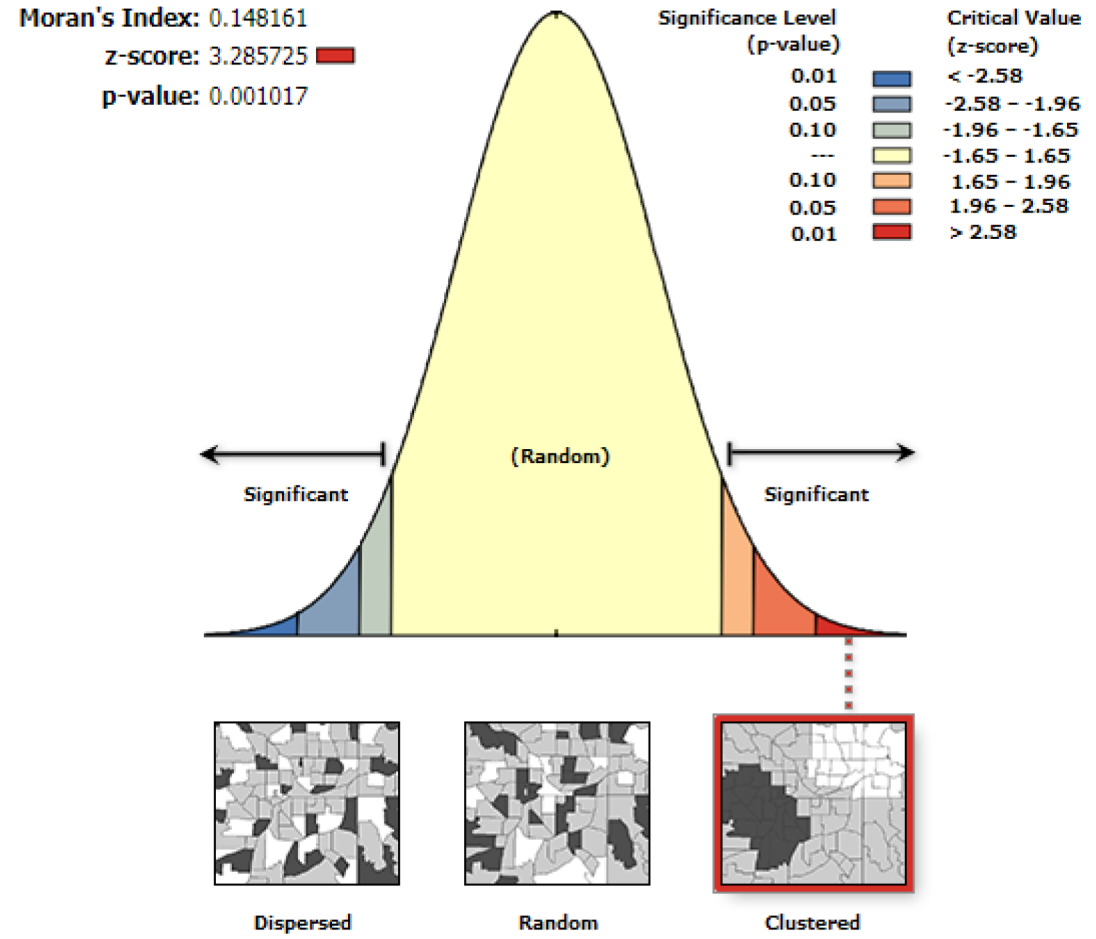

FIGURE 1
Spatial autocorrelation utilization of contraceptive methods among married women in Ethiopia, EDHS 2019.

[AOR = 0.29, CI 95%: (0.22, 0.37)] times less likely to be contraceptive users than mothers classified from 10 to 19 years old. Mothers whose children number is from 3-to 5 have [AOR = 1.26, CI 95%: (1.03, 1.52)] times more positive inclination to use contraceptives than mothers who have six and move children. Mothers from high levels of community-level women's education have shown [AOR = 1.61, CI 95%: (1.21, 2.15)] times probability of utilizing contraceptives. Participants from Amhara, Oromia, Benishangul and SNNPR regions have revealed [AOR = 2.40, CI 95%: (1.53, 3.77)], [AOR = 1.64, CI 95%: (1.05, 2.56)], [AOR = 1.62, CI 95%: (1.01, 2.62)] and [AOR = 2.04, CI 95: (1.31, 3.19)] times more tendency to utilize contraceptive methods than Tigray region respectively. In contrast, Somali and Afar regions have [AOR = 011, CI 95%: (0.05, 0.22)] and [AOR = 0.31, CI 95%: (0.18, 0.54)] times less likely to use contraceptive services than Tigray Region respectively (Table 4).

Discussion

The present study has attempted to assess the current status of contraceptive method utilization among married reproductive-age women in Ethiopia. The current contraceptive utilization was found at 41.25% (39.98, 42.53) only. This finding is higher than studies done in Ethiopia in 2016 29.2% (22); however, it is lower than studies conducted in Ethiopia 63.4% (24) in 2017, and almost the same as a study done in Indonesia 38.5% (41) in 2020, and Nigeria 39.2% (42) in 2018. Because of the countries' profiles of family planning experience, participants' attitudes, knowledge, and educational backgrounds toward family planning desire, it's probable that the findings from this research are less than those of the previous one. On the other hand, this study discovered a considerably higher prevalence of contraceptive intention, which could be due to limiting confounding factors at both the individual and community levels, which could have positive or negative effects on contraceptive use. This research indicated that women's decisions to use contraceptives were based on individual characteristics with a small sample size and study environment. It's possible that this influenced their prevalence findings.

This study declared that age was a determinant factor of contraceptive methods. Participants aged 25–34 years and 35–49 years are less likely to use contraceptives in their future families than the 19–24 years old mothers. This study discovered the

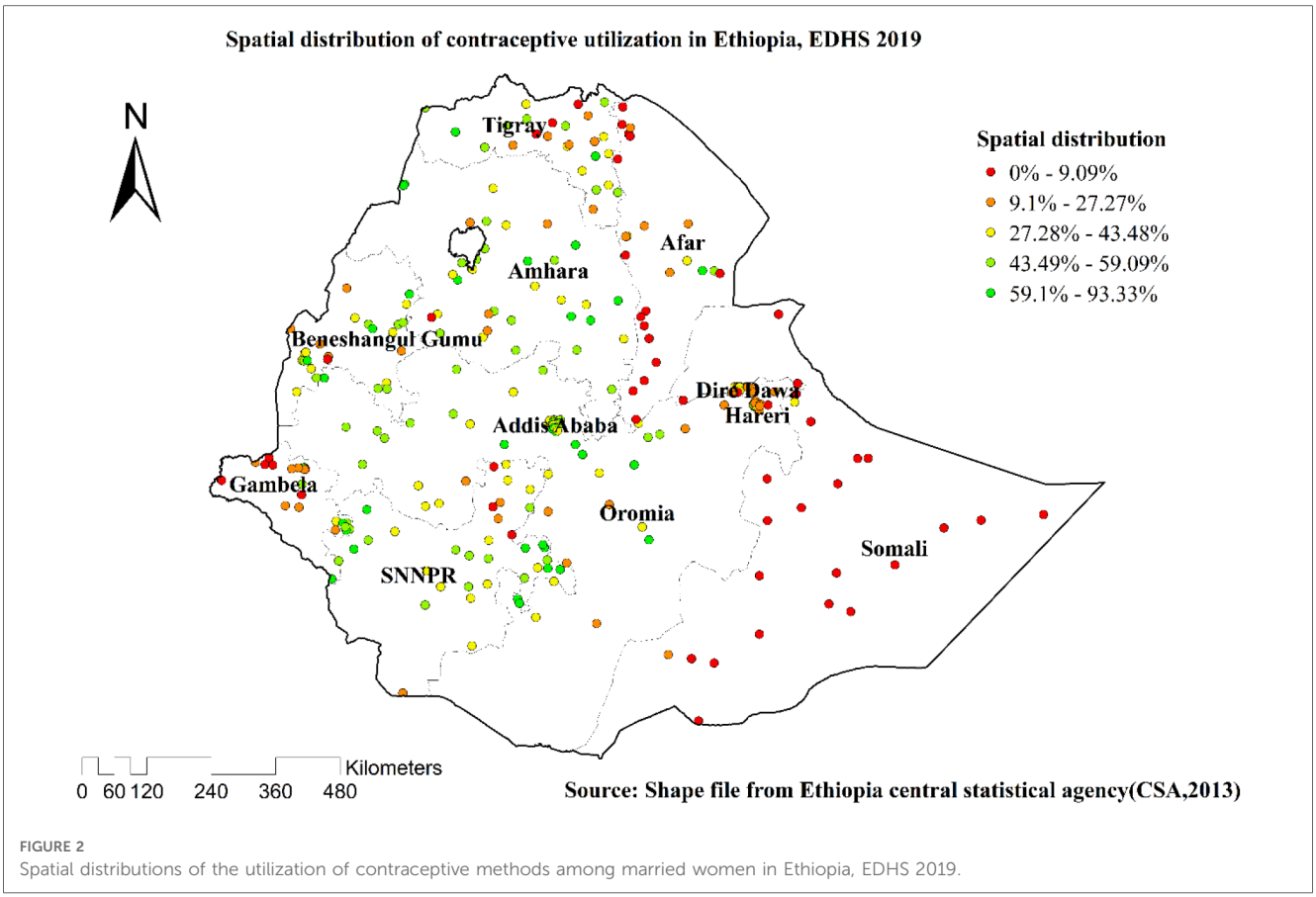

FIGURE 2
Spatial distributions of the utilization of contraceptive methods among married women in Ethiopia, EDHS 2019.

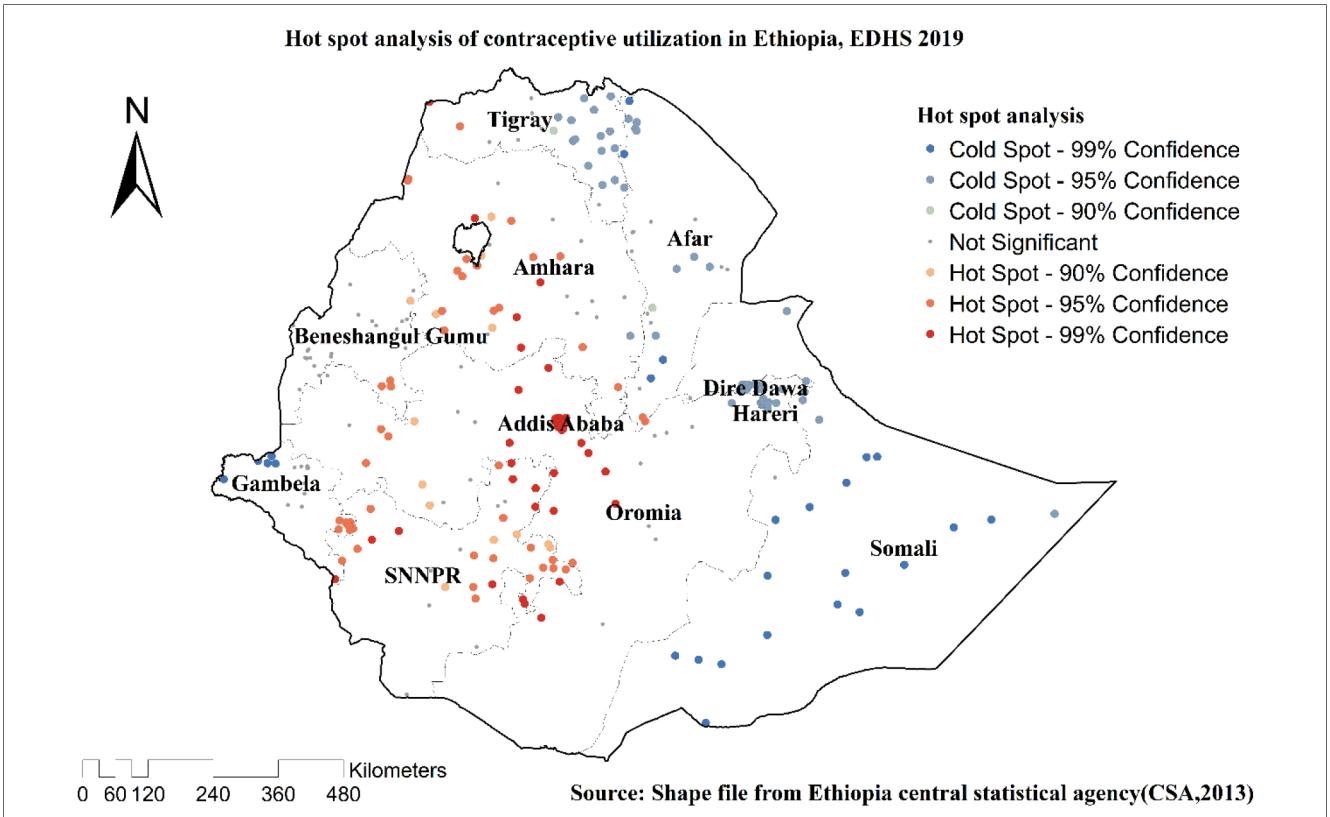

FIGURE 3
Hot spot analysis of the utilization of contraceptive methods among married women in Ethiopia, EDHS 2019.

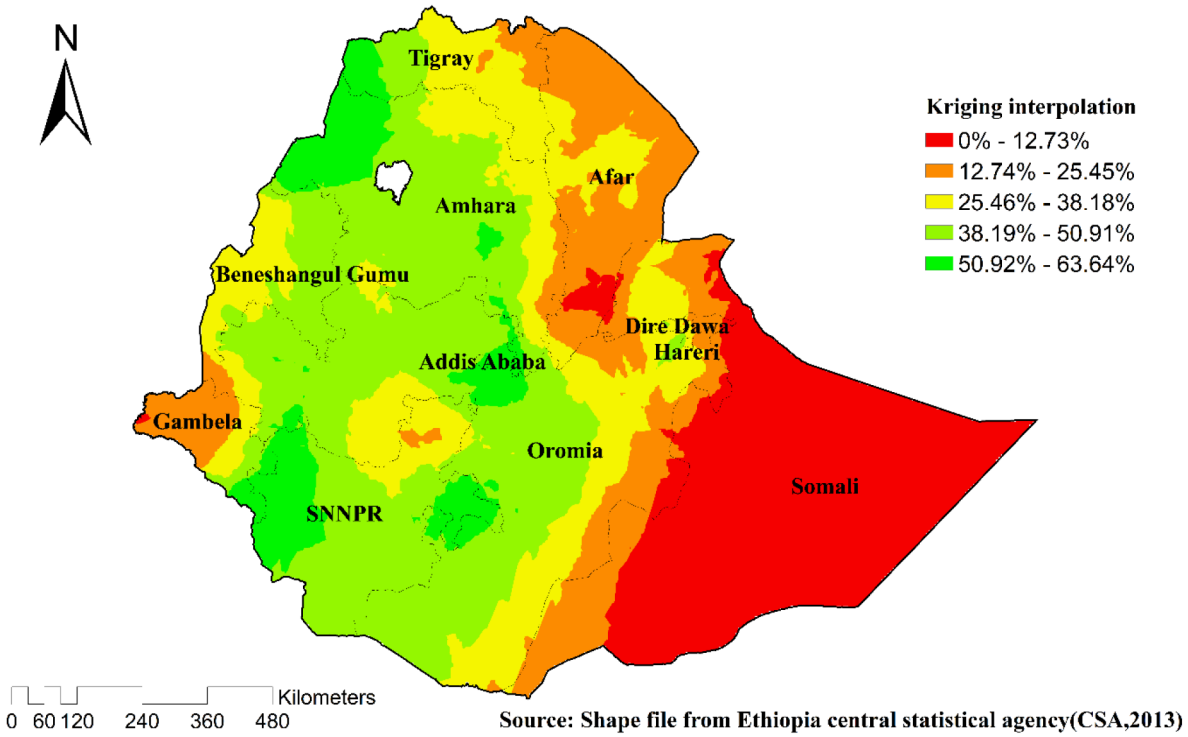

FIGURE 4
Kriging interpolation analysis of the utilization of contraceptive methods among married women in Ethiopia, EDHS 2019.

same finding as studies done in Malawi (43), Nigeria (44), Indonesia (45), and Ethiopia (22, 46). This could be explained by it being well known that as a mother gets older, her chances of having a baby decrease even if she needs and desire to use contraceptive may decrease. On the other hand, as mothers get older, their chances of finishing their education journey increase, and their desire to have a baby increases. They may also not use contraceptives because they are more likely to live by themselves and manage their income and way of thinking. They are also more likely to have their source of income. Another possibility is that this group consisted of women who were either done having children or desired to spread them out, in contrast to the second group, which consisted of women who had not yet started having children. Another factor would be that teens were less likely to seek family planning services as a result of societal expectations that they shouldn't engage in premarital sex. The low frequency of contraception among women between the ages of 15 and 24 is probably caused by the fact that the majority of these women participate in risky sex, are newlyweds, and believe that marriage should be centered on the institution of having children. For a young mother, it may be challenging to get access to contemporary family planning services (47, 48).

The study also figured out that participants with primary, secondary, and higher educational levels have more likelihood of a positive tendency to utilize contraceptives than participants with no education. This study declared similar findings to studies done in Nigeria (44), East Africa (49), and Ethiopia (22, 24, 46). Possible justification might include educated women who may have better information and a positive attitude about birth control compared to uneducated women. In addition, as these

TABLE 3 Significant spatial clusters with high-rate contraception utilization among married women in Ethiopia, EDHS, 2019.

Cluster	Enumeration areas (Cluster detected)	Coordinates (radius)	Population	Cases	RR	LLR	*p*-value
1	118, 92, 120, 94, 169, 86, 168, 155, 207, 208, 209, 167, 170, 211,93, 154, 230, 156, 212, 150, 153, 152, 147, 213, 229, 218, 151, 157,194, 149, 217, 97, 214, 164, 225, 221, 226, 220, 206, 227, 222, 161,223, 210, 224, 228, 158, 166, 98, 160, 96, 146, 148, 195, 201, 163,91, 200, 87, 119, 95, 77, 215, 219, 162, 80, 159, 79, 165, 174, 216,112, 52, 171, 204, 196, 179, 176, 99, 72, 177, 180, 191, 76, 189, 53,73, 173, 75, 70, 205, 190, 192, 71, 178, 203, 74, 259, 198, 81, 54,262, 100, 260, 261, 257, 258, 274, 275, 276, 263, 265, 256, 277, 175, 264, 270, 279, 266, 267, 273, 278, 280, 271, 197, 268, 59, 199, 272,269, 184, 116, 57, 101, 187, 185, 115, 60, 90, 182, 84, 181, 67, 172,58, 186, 188, 65, 82, 51, 85, 55, 202	(8.944357 N, 35.279628 E)/468.49 km	2,870	1,250	1.72	106.73	0.0001

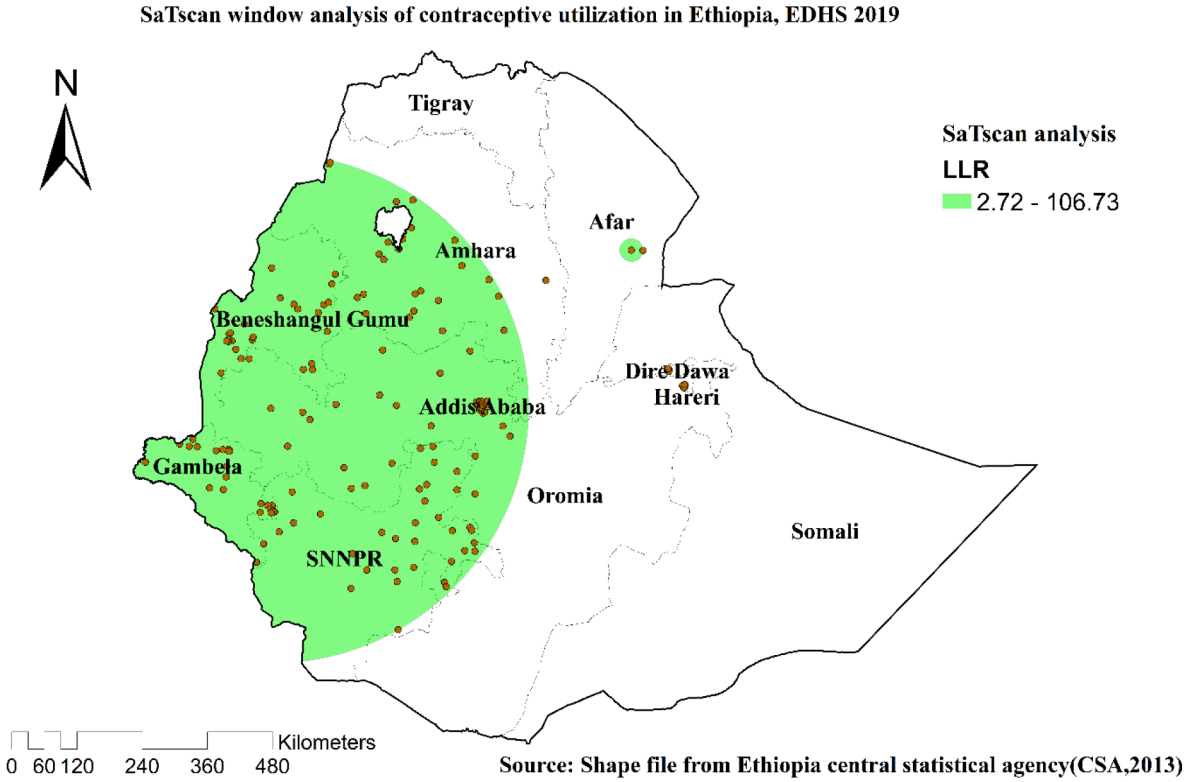

FIGURE 5
SaTscan scan statistics of the utilization of contraceptive methods among married women in Ethiopia, EDHS 2019.

women learn, their ability to become more self-reliant will increase, and they will be able to cope with the harmful effects of society. Alternatively, these educated women may be residents of urban areas and enjoy more family planning services.

Mothers classified under the middle, richer and richest wealth status index have more likelihood of a positive tendency to utilize contraceptives than participants classified under poorest. This finding is in agreement with other studies done in Uganda (50), East Africa (49), and Ethiopia (46, 51). In countries like Ethiopia, it is common for husbands to dominate and have self-determination (52, 53). Therefore, better-off mothers have a greater right to self-determination than the poorest mothers to spend on transportation and use what they want to stay healthy. In other words, poor mothers may not have the information and may simply consider giving birth as an option and source of income generation. Although contraption is free of charge in Ethiopia, this could be due to the direct or indirect fees that women may spend in order to obtain contraception. Another explanation could be biases and misconceptions about contraception use. Women may assume that contraception is unsuitable for women who work hard, as poor women typically do. Another factor that has been linked to contraceptive use in previous studies is exposure to family planning messaging in the media (51, 54, 55).

Those mothers having 1–4 times antenatal care follow up during their pregnancy have shown a better tendency to use contraceptives than did not have antenatal care follow-ups during their pregnancy period. This judgment is incongruent with other investigations investigated in middle and lower-income countries (56). Mothers having antenatal care follow-up during pregnancy leads mothers to benefit more from a family planning package, as they are better informed and counselled by health professionals than unsupervised (45). On the other hand, they may have a better view of family planning (45).

On the other hand, mothers who have given their first birth at 35–44 years old are less likely to be contraceptive users than mothers classified from 10 to 19 years old. This statistically significant outcome came up similar to the results of studies done in Uganda (50). This is actual logic because these mothers did not give birth in the age range they were supposed to give birth to, and now they are too old to try to have a baby before they stop giving birth. As a result, women between the ages of 10 to 19 are more likely to use contraceptives than 35–44 women.

Mothers whose children number is from 3-to 5 have a higher positive inclination to use contraceptives than mothers who have six and move children. This outcome has gone similarly to studies done in Malawi (57), Iran (58), Ghana (59), Uganda (50), and Ethiopia (60). Mothers who have given birth to 3–5 children are more likely to have contraceptives than mothers who have given birth to six and more than six children due to their sociodemographic variance. Alternatively, mothers with six or more children may not be able to use contraceptives because they may be too old to give birth and desire not to have more children (24, 49, 53, 60).

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TABLE 4 Individual and community-level factors associated with contraceptive utilization among married/in-union women in Ethiopia (n = 5,743).

Variables	Null model	Model I	Model II	Model III
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Age				
15–24		1		1
25–34		0.84 (0.69, 1.02)		0.80 (0.66, 0.96)*
35–49		0.53 (0.41, 0.68)*		0.50 (0.38, 0.64)*
Highest educational level				
No-formal education		1		1
Primary		1.52 (1.29, 1.79)*		1.47 (1.25, 1.73)*
Secondary		1.49 (1.15, 1.92)*		1.42 (1.09, 1.83)*
Higher		2.03 (1.49, 2.77)*		1.92 (1.41, 2.60)*
Household wealth index				
Poorest		1		1
Poorer		1.62 (1.27, 2.07)*		1.25 (0.98, 1.59)
Middle		2.13 (1.65, 2.75)*		1.48 (1.14, 1.90)*
Richer		2.10 (1.61, 2.75)*		1.41 (1.07, 1.86)*
Richest		2.96 (2.20, 3.96)*		2.17 (1.52, 3.11)*
Place of delivery				
Home		1		1
Health facility		1.12 (.92, 1.36)		1.08 (0.86, 1.29)
Number of ANC follow up				
No ANC follow up		1		1
1–4 ANC follow up		1.74 (1.25, 2.02)*		1.60 (1.26, 2.03)*
More than four follow up		1.38 (1.06, 1.79)*		1.28 (0.98, 1.66)
Age of respondent at first birth				
10–19 years		1		1
20–34 years		1.06 (0.91, 1.24)		1.08 (0.92, 1.26)
35–44 years		0.28 (0.22, 0.36)*		0.29 (0.22, 0.37)*
Number of children				
0–2		1.19 (0.93, 1.53)		1.19 (0.93, 1.53)
3–5		1.27 (1.05, 1.55)*		1.26 (1.03, 1.52)*
6 and above		1		1
Number of health facility visit				
1–2		1		1
3–5		1.18 (0.93, 1.49)		1.15 (0.91, 1.46)
Place of residence				
Urban			1	1
Rural			0.81 (0.59, 1.10)	1.12 (0.79, 1.60)
Region				
Tigray			1	1
Afar			0.27 (0.16, 0.46)*	0.31 (0.18, 0.54)*
Amhara			1.99 (1.23, 3.08)*	2.40 (1.53, 3.77)*
Oromia			1.41 (0.92, 2.17)	1.64 (1.05, 2.56)*
Somali			0.06 (0.03, 0.14)*	0.11 (0.05, 0.22)*
Benishangul			1.44 (0.91, 2.29)	1.62 (1.01, 2.62)*
SNMP			1.73 (1.12, 2.65)*	2.04 (1.31, 3.19)*
Gambela			0.98 (0.61, 1.58)	0.98 (0.60, 1.60)
Harari			0.74 (0.46, 1.20)	0.70 (0.43, 1.16)
Addis Ababa			1.19 (0.71, 2.01)	1.21 (0.71, 2.07)
Dire Dawa			0.64 (0.39, 1.04)	0.67 (0.40, 1.11)
Community-level women education				
Low			1	1
High			1.31 (1.01, 1.69)*	1.11 (0.85, 1.45)
Community-level women wealth status				
Low			1	1
High			1.89 (1.46, 2.45)*	1.61 (1.21, 2.15)*
Random parameters and model comparison				
Community-level variance	1.27	0.87	0.43	0.45
ICC (%)	27.67	21.02	11.51	12.01
MOR (95% CI)	2.87 (2.57, 3.32)	2.43 (2.18, 2.76)	1.86 (1.71, 2.06)	1.89 (1.73, 2.10)
PCV (%)	Reference	28.86	65.20	63.41
LR	−3,353.36	−3,155.27	−3,226.57	−3,067.03
DIC (2LLR)	6,706.72	6,310.54	6,453.14	6,134.06
AIC	6,710.727	6,348.53	6,483.145	6,198.07

*Significant at p-value <0.05.
ICC, Intra cluster correlation, MOR, Median Odds Ratio, PCV, Proportional Change of Variance, DIC, Deviance information criterion, LLR, Log Likelihood Ratio, AIC, Akaike information criterion.

Mothers from high levels of community-level women's education have revealed a higher probability of utilizing contraceptives than their counterparts. The study agreed with other literature conducted in Nigeria (44) and Uganda (50). When the individuals around her have a positive attitude toward modern contraception and have better quality and healthier kids, for example, the mother will get more outstanding bravery and self-confidence to use them. She might persuade others in her society that contraception is beneficial for her, her kid, and her family. Or, if she has a mistaken perspective of birth control, she is more likely to gain from it if most of the population benefits. Then quickly finds the information she requires.

Through her friends and neighborhood participants from Amhara, Oromia, Benishangul, and SNNPR regions, p has revealed more tendency to utilize contraceptives. In contrast, the Somali and Afar regions are less likely to use contraceptive services than the Tigray Region, respectively. This impressive result has made a similar conclusion to studies done in Ethiopia (22, 60). This could be explained by the Amhara, Oromia,

Benishangul, and SNNPR regions, compared to others, which have the highest population density in Ethiopia, with a relatively well-developed population in economic, political, and awareness aspects of contraceptive methods and have better access, availability to medical care with the number of nearby health facilities, so they are more likely to use contraception. Besides these factors, policy makers and implementers in these regions might have accomplished a good achievement with great passion.

On the other hand, regions such as Somali and Afar may be difficult for health professionals interventions and access due to poor health coverage, limited access to information, and limited health care access (49). In addition to the fact that most of them in these regions are uneducated, they do not know much about contraception. People also might believe that having many children is considered a source of wealth and a symbol of blessing by God. Furthermore, since these people live in rural and desert areas and nomadic lives, it is difficult to intervene and educate them (60).

The strength of this study includes the use of a large sample size. As the sample size increases, the sample gets closer to the actual population, which decreases the potential for deviations from the actual population, and it could be reliable to use by other upcoming researchers. In addition to this, an advanced statistical model that can take the nature of the data into account was employed. However, the present study should be interpreted with several limitations; because of the cross-sectional nature of the study, making causal inferences about the observed associations might not be possible. Moreover, social desirability bias might be introduced as the data were entirely based on self-reports.

Conclusion

This study revealed that contraceptive usage among married women is comparatively low, with wide regional variation. Women's age, educational status, wealth status, number of children born, antenatal care follow-up, regions, age at first birth, and women from high-level communities were statistically significant variables linked to contraceptive use. The government and other vital actors of maternal and child health stakeholders can facilitate activities, increase knowledge and change attitudes about contraception by supporting and guiding health providers, community leaders, health extension workers in Afar and Somali regions. On the other hand, region-based intervention, mentoring, and funding support may have a favorable influence on contraception coverage in the mentioned regions, including those identified in the spatial study. It is preferable to raise awareness among mothers about ANC, and assist those who are financially disadvantaged or do not have access to health facilities. As a result, public health interventions, particularly those that can improve contraceptive information dissemination and community-level contraceptive utilization rates, are urgently needed at the national level to address potential barriers.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

The study is based on secondary data from the EDHS. The EDHS authorities handled concerns of informed consent, confidentiality, anonymity, and privacy of the study sample ethically, and we did not change or use the data for other purposes.

Author contributions

BT: Conceptualization, data curation, formal analysis, inquiry, technique, resources, software, validation, visualization, writing – first draft, writing – review & editing. MG, YA, YB, MD, YG, AG, DB, and DB: Data collection, formal analysis, inquiry, technique, resources, software, validation, visualization, initial draft writing, review & editing writing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Access to PrEP and other sexual health services for cisgender women in the United States: a review of state policy and Medicaid expansion

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Pre-exposure prophylaxis (PrEP) has the potential to prevent new HIV infections, but it is unclear how state policies governing sexual and reproductive health services (SRH) impact access for cisgender women. The objective of this review is to identify barriers to PrEP access for cisgender women in the United States. Using the CDC Atlas Program, 20 states with the highest HIV incidence among cisgender women were included in this analysis. Through a search conducted in May–July 2022 of CDC, PrEPWatch.org, and other State Department and Insurance websites, Medicaid expansion status, pharmacist PrEP prescribing laws, financial support programs, and Traditional Medicaid coverage of PrEP, HIV testing, and emergency contraception were reviewed. Of the included states, nearly half did not expand Medicaid at the state level. Emergency contraception and HIV testing was covered under Traditional Medicaid for almost all included states, but insurance stipulations and eligibility requirements remain. Although PrEP is covered under all Traditional Medicaid plans, six states require pre-authorization. Three states have HIV testing mandates, four allow pharmacists to prescribe PrEP and six have financial support programs to cover the cost of PrEP. Medicaid expansion, pre-authorization requirements for PrEP prescriptions and emergency contraception, and limitations on pharmacist prescribing abilities were identified as barriers to SRH access for cisgender women. Medicaid expansion should be prioritized as an approach to expanding access to HIV prevention services at the state level.

KEYWORDS

PrEP, women, sexual and reproductive health, Medicaid, policy, United States

Introduction

Legislation and other government policies impact the way in which individuals interact with the health care system, in many cases reducing access to critically needed services (1, 2). This is especially the case in sexual and reproductive health and HIV care, where women and other birthing persons face restrictions on sexual education and reproductive rights due to limitations on insurance expansion; these limitations perpetuate cycles of poor access to and retention in care, and high rates of unintended pregnancy and HIV transmission. These restrictive laws are informed by, and perpetuate mass incarceration, poverty, racism,

homophobia, inequitable gender norms and other inequities that facilitate the risk-taking behaviors that contribute to increased HIV incidences among vulnerable populations (3). These factors increase the susceptibility of cisgender women to HIV infection and worsen their long-term health outcomes (2).

In 2019, there were 36,801 new HIV diagnosis in the United States, of which 19% were among cisgender women for whom heterosexual contact is the dominant mode of acquisition (4). Racial disparities in HIV among US women are stark; 93% of new HIV infections among Black women would not have occurred if incidence were the same for Black as for White women (5). The HIV mortality rate is nearly six per 100,000 among Black women, compared with 0.3 among White women (6). There are several challenges that contribute to cisgender women's vulnerability to HIV infection; factors like racism, discrimination, and HIV-stigma influence access to and the quality of care received by women, particularly women of color; higher risks of exposure due to engagement in receptive sex; and inequitable gender norms that contribute to intimate partner violence and imbalances in health decision making power (7). Additionally, many women may not perceive their risk to be high due to their relationship status with male partners that are expected to be monogamous. HIV infection can be prevented by HIV pre-exposure prophylaxis (PrEP), a medication that is ~62–84% (8–11) efficacious among women when taken consistently. Yet, in the US, PrEP is prescribed to just 2% of the ~468,000 women whose main mode of acquisition is heterosexual sex (12). While much of the marketing for PrEP has targeted men who have sex with men (MSM) and transgender individuals, cisgender women may also benefit from its' use (10, 11). To achieve the goal of ending the HIV epidemic, it is critical that we increased use and acceptability of PrEP among cisgender women.

Despite data on PrEP efficacy, in 2020, only 10% of cisgender women who could benefit from PrEP were prescribed it in the United States (4). When these data are evaluated by racial group, the differences are even more concerning; Black and Hispanic/Latino individuals represent the group for whom PrEP is recommended but have the lowest rates of use among all racial/ethnic groups; preliminary CDC data show only 9% (42,372) of the nearly 469,000 Black people and only 16% (48,838) of the nearly 313,000 Hispanic/Latino people who could benefit from PrEP received a prescription in 2020 (13). These data highlight the racial and gender inequities that drive the HIV epidemic; there is a critical need to address the root causes, particularly the laws and policies that facilitate these disparities, including poverty, housing instability, unequal access to health care, lack of education, stigma, and systemic racism. The consideration of these intersections are timely, as the UNAIDS Global AIDS Strategy for 2021–2026 is particularly focused on addressing the inequities that drive the AIDS epidemic and is situated within the UN Sustainable Development Goals that guide policy decision making (14).

There have been several policy changes under the Affordable Care Act to support usage of PrEP. In June 2019, a national panel of health experts concluded that PrEP was a crucial tool in fighting the AIDS epidemic. The decision to classify PrEP as an effective preventative service prompted rules requiring health insurance to cover the expenses under the terms of the Affordable Care Act; insurance companies were required to comply with this order by January of 2021. The Department of Labor amended these guidelines in July 2021 after facing opposition from the insurance industry, which stated that patients should not be charged for medical services related to a PrEP prescription, including doctor visits and laboratory tests. The states that extended their Medicaid programs under the Affordable Care Act and those that provided programs to defray the costs of PrEP benefited from greater usage of the preventative modality (15). In other words, if PrEP is available for free or at a reduced cost, more people utilize it. Uptake of PrEP for HIV prevention has significant cost savings implications for both insurance companies and the health system overall, as an evaluations in the United States indicate a lifetime savings of over $200,000 USD for each HIV infected averted by PrEP use (16).

Many uninsured women are eligible for insurance coverage but are not enrolled. In 2020, one million women were in the "Medicaid coverage gap," which affected one in every five (2.1 million) uninsured women who qualified for Medicaid but were not enrolled (17). These women remain ineligible for Medicaid because they live in a state that has not extended its Medicaid program, but are eligible for Health Insurance Marketplace subsidies which helps to lower or eliminate the out-of-pocket cost of monthly premiums for health coverage (18) because their income is less than the lower income limit (100% FPL) (17). Medicaid expansion is linked to an array of health benefits, including more equitable access to PrEP and drug assistance programs to help fill gaps and cover costs (17). In 2018, 20% of people living with HIV (PLWH) lacked health insurance in non-expansion states, compared to 6% in expansion states; Medicaid coverage was more prevalent in expansion states (46% vs. 30%) among the states studied (17). This review explores attributes of state-level laws and programs that may impact access to PrEP for cisgender women in a sample of U.S. states with higher HIV incidence. Attributes of interest include Medicaid coverage of key sexual health services, PrEP prescription requirements, and financial support programs related to service acquisition.

Methods

This study included a review of state-level laws and programs that govern and impact the accessibility of PrEP and other SRH services for cisgender (women assigned female at birth and currently identify as female) women in the United States.

Inclusion criteria

Using the CDC Atlas Plus program, data on new HIV diagnoses among cisgender women by state were obtained on May 4, 2022. We used the 2019 CDC dataset as it was the latest, most comprehensive dataset available. The 20 U.S. States and Territories with the highest rates of new HIV infections among cisgender women in 2019 were included in this analysis.

Search strategy

We conducted an internet search for state policies related to sexual and reproductive health access for cisgender women using the following key words: ["Pre-exposure prophylaxis OR PrEP"] AND ["Policy" OR "Strategies" OR "Guidelines"] AND ["Women" OR "Girls"]. We specifically targeted reports by the CDC and PrEPwatch.org, a website that tracks the global availability of PrEP and ongoing

medication trials. We searched the official websites of State Departments of Health and of state governments responsible for regulating access to medical interventions (including prevention, testing and/or screening, and treatment) to identify policies related to PrEP and women's rights to sexual and reproductive health services. Our policy search was conducted from inception until 21 July 2022.

Data extraction

The following variables were extracted and compiled for the included states: Medicaid expansion status, PrEP pre-authorization requirements, pharmacist PrEP prescribing laws, PrEP financial support programs, and Traditional Medicaid coverage of the following services: PrEP, HIV testing, emergency contraception and coverage status without a prescription. These data were documented in tabular form in Microsoft Excel for analyses. The research team met to discuss findings and exchange information, and adjusted search strategies as necessary. We defined Medicaid expansion status as implementing Medicaid expansion before June 1, 2022 (18).

Results

The following U.S. states represent the states and territories with the highest HIV incidence among cisgender women in 2019, in order from highest to lowest: District of Columbia, Georgia, Maryland, Florida, Louisiana, Mississippi, Texas, Alabama, West Virginia, New Jersey, Delaware, South Carolina, Nevada, New York, North Carolina, Arkansas, Puerto Rico, Tennessee, Massachusetts, Illinois. Table 1 shows the included states and key domains of inquiry.

Medicaid expansion and coverage

Table 1 shows the state Medicaid expansion status and care coverage under Traditional Medicaid. Of the 20 states with the highest HIV incidence among cisgender women, almost half did not expand Medicaid at the state level. Although PrEP is covered under all Traditional Medicaid plans, six of the included states require pre-authorization, representing a barrier to care initiation. HIV testing for all populations was covered by Traditional Medicaid in all states, except for Florida, which dictates that an individual must be considered 'high risk' per CDC guidelines to receive HIV testing. CDC guidelines list the following HIV risk behaviors for cisgender women: in the past 12 months, had sex without using any HIV prevention strategy (had sex with a partner whose status was unknown, or was HIV positive and not virally suppressed; had sex without using a condom; had sex with someone who was not taking PrEP) and/or used a syringe or any other injection equipment after someone else used it.

Emergency contraception was covered under Traditional Medicaid for almost all states included in this analysis; Georgia and Mississippi do not cover these services, and data on Arkansas and Puerto Rico remain unclear. Of the 16 states that covered emergency contraception, DC, Maryland, New Jersey, New York, and Illinois require a prescription, Alabama requires prior authorization and North Carolina requires beneficiaries to be enrolled in the prescription benefit plan for insurance coverage to be used. While a prescription is not needed in Florida, emergency contraception benefits are only accessible for individuals 12 years and older. In summary, only 8 of the 16 states that cover emergency contraception have no insurance related barriers to receipt.

Other policies influencing PrEP accessibility

State-level HIV testing mandates and pharmacist PrEP prescribing capabilities were also reviewed. Only three of the included states, New York, Nevada, and Illinois had HIV testing mandates that require primary care and emergency providers to offer HIV testing to all patients. A fourth state, Delaware, has implemented an opt-out program that integrates HIV testing into routine laboratory testing, and requires patients to intentionally opt-out of that lab test. These approaches aim to expand accessibility and normalize and reduce the stigma around HIV testing. While the District of Columbia does not have a HIV testing mandate, they have required all insurers to cover the cost of HIV testing in the Emergency Department, a step in expanding access to screening. Florida, Nevada, North Carolina, and Tennessee have passed legislation to allow pharmacists to prescribe PrEP; prescriber training requirements are included in Table 2. Five additional states, Maryland, New Jersey, New York, Massachusetts, and Illinois have bills pending that would expand PrEP prescribing access to Pharmacists.

PrEP financial support programs

National and State-level PrEP financial aid programs, eligibility and benefits were reviewed. Seven national financial support programs were identified; three programs were established by pharmaceutical companies, Gilead Sciences, a Biotechnology company that researchers and develops antiviral drugs, and is creator of Truvada for PrEP, and ViiV Healthcare Limited, a joint venture by Pfizer and GlaxoSmithKline. The remaining programs were established by Foundations providing financial assistance for medical expenses. In addition to the national level programs, six states have established financial support programs to cover the cost of PrEP. Lastly, two telemedicine programs offering comprehensive PrEP care, including laboratory screenings were identified. Interestingly, one company offers two different programs, one specifically targeting cisgender women. Program details, patient eligibility and benefits are described in detail in Table 3.

Discussion

This analysis of 20 U.S. states and territories with high HIV incidence among cisgender women reviewed sexual and reproductive health policies that may represent barriers to receipt of care. While PrEP is covered under Traditional Medicaid nationwide, barriers related to pre-authorization requirements, cost, and provider accessibility remain; only four of the included states have passed legislation to allow pharmacists to prescribe the HIV prevention medication and only six states have financial support programs available. Similar barriers were identified for emergency contraception and HIV testing, which were not covered by Traditional Medicaid in all included states.

TABLE 1 U.S. state policies related to sexual and reproductive health coverage.

		Coverage under traditional Medicaid							
State (by rate per 100,000, high to low)	Medicaid expansion state	PrEP	Requires pre-authorization	HIV test	Emergency contraception	Prescription needed	HIV testing mandate	Pharmacists prescribe PrEP	State financial support programs
District of Columbia	Yes	Yes	Yes	Yes	Yes	Yes	No, all insurance covers testing in the ED	No	Yes
Georgia	No	Yes	No	Yes	No	N/A	No	No	No
Maryland	Yes	Yes	Yes	Yes	Yes	Yes	No	Bill pending	No
Florida	No	Yes	No	At-risk only	Yes	No, minimum age 12	No	Yes	No
Louisiana	Yes	Yes	No	Yes	Yes	No	No	No	No
Mississippi	No	Yes	Yes	Yes	No	N/A	No	No	No
Texas	No	Yes	No	Yes	Yes	No	No	No	No
Alabama	No	Yes	No	Yes	Yes	No, req. prior authorization	No	No	No
West Virginia	Yes	Yes	No	Yes	Yes	No	No	No	No
New Jersey	Yes	Yes	Yes	Yes	Yes	Yes	No	Bill pending	No
Delaware	Yes	Yes	Yes	Yes	Yes	No	Routine opt-out testing	No	No
South Carolina	No	Yes	Yes	Yes	Yes	No	No	No	No
Nevada	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
New York	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Bill pending	Yes
North Carolina*	No	Yes	No	Yes	Yes	No, prescription pharmacy benefit only	No	Yes	Yes
Arkansas	Yes	Yes	No	Yes	Unclear	Unclear	No	No	Yes
Puerto Rico	Yes	Yes	No	Yes	Unclear	Unclear	No	No	No
Tennessee	No	Yes	No	Yes	Yes	No	No	Yes	No
Massachusetts	Yes	Yes	No	Yes	Yes	No	No	Bill pending	Yes
Illinois	Yes	Yes	No	Yes	Yes	Yes	Yes	Bill pending	Yes

* Medicaid coverage under expansion in North Carolina began on December 1, 2023 after this analysis was completed.

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TABLE 2 Pharmacist PrEP prescriber requirements.

State	Legislation	Education requirements	Prescribing criteria
Florida	House Bill 389 • Expands pharmacy practice to include certain drug therapy services, including PrEP • Under Collaborative Pharmacy Practice Agreement (CPPA), testing and treatment under a written protocol with a supervising physician	• Doctor of Pharmacy Degree or 5 years of experience as a licensed pharmacist • License renewal every 2 years with an 8-h continuing education course • 20-h course: performance of patient assessment; ordering, performing, and interpreting clinical and laboratory tests	• Professional liability insurance coverage • Patient records medical system for at least 5 years
North Carolina	House Bill 96 • Under CPPA and standing order from collaborating physician, may dispense without a prescription • Pharmacists must counsel patients and notify primary care provider of PrEP usage	• Doctor of Pharmacy degree • Bachelor of Science in Pharmacy • Completed two NCCPC or ACPE approved certificate programs • Completion of an ASHP accredited residency program	• CPPA with a physician licensed in NC who has prescribing authority, including of controlled substances, approved by the North Carolina Board of Pharmacy • 5 years of clinical experience
Tennessee	Tennessee Board of Pharmacy Rule 1140–03-0.17 (5)(b) • Under CPPA and standing order from collaborating physician, may dispense PrEP without a prescription • Pharmacists must counsel patients and notify their primary care provider of PrEP usage	• Doctor of Pharmacy degree OR Bachelor of Science degree in pharmacy and in active practice • Pass the NAPLEX and MPJE • Licensed by Tennessee Board of Pharmacy	• CPPA with a physician, that includes guidelines for treatment, screening, and preventative care • CPPA is renewed and updated every 2 years
Nevada	Nevada Senate Bill 325 • Pharmacists may prescribe, dispense, and administer PrEP • Requires all state regulated health plans, including Medicaid and state employee plans, to provide coverage and reimbursement for medications and related pharmacist clinical services at a rate equal to other practitioners	• Doctor of Pharmacy degree • Pass the NAPLEX and the MPJE • Licensed by Nevada Board of Pharmacy	• Complete a two-hour education course approved by ACPE • Liability insurance coverage of 1 million dollars • Pharmacist must complete patient HIV screening assessment and counseling on proper use of medication

Medicaid expansion and service utilization

In 2022, states with expanded Medicaid programs had 1.4 times higher PrEP use rates compared to those without expansion (19) (AIDvu). State-led Medicaid expansion under the Affordable Care Act expanded insurance coverage to nearly all adults with incomes up to 138% of the Federal Poverty Level, expanded parent coverage of dependents until the age of 26, and provided states with an enhanced federal matching rate for their expansion populations (18). These changes were critical in providing health insurance, and for increasing accessibility of resources across the health system.

Several studies have investigated the relationship between Medicaid expansion and PrEP use. Previous work to compare care coverage and utilization among MSM found that MSM in states that did not expand Medicaid were less likely to have insurance, utilize health care or access PrEP; MSM in expansion states were more likely to use PrEP (20). Additionally, they found that 20% of HIV positive and 30% of HIV negative MSM in non-expansion states were uninsured (20). In an additional analysis exploring PrEP uptake by MSM and transgender individuals, Carneiro and colleagues found that individuals in states without Medicaid expansion had 31% lower odds of being current PrEP users (aOR = 0.69, 95% CI 0.54–0.88), than individuals living in states with full expansion (aOR = 0.73, 95% CI 0.56–0.95) (21). This data is further complicated by gender identity; those who identified as female or as a transgender person had 66 and 29% significantly lower odds of being current PrEP users than those identifying as male (21). These findings are consistent with uptake of HIV testing, as Medicaid expansion has been shown to be associated with significant increases in testing (22–24).

These data highlight the positive relationship between access to health insurance and care uptake, yet there are still challenges for women when it comes to persistent PrEP use (the length of time with consistent refills) and the uptake of critical sexual health services (25). While it has been noted that commercially insured persons have a longer period of PrEP persistence than Medicaid insured persons, there are also some differences in sex (26). One year after starting PrEP, 21% of women with Medicaid insurance continued taking it, compared to 32% of men; PrEP persistence for women was 5.8 months compared to 7.1 months for men (26). While there is little information on the causes of these disparities in persistence, several explanations have been put forth, including varying degrees of HIV and PrEP -related stigma, limited access to healthcare, financial limitations, or less encouragement to continue using PrEP by their community or healthcare provider. Under the Affordable Care Act, preventive services, like HIV testing, remain covered at no out-of-pocket cost, which helps remove financial barriers to screening and facilitates increased engagement in the health system (23). Following Medicaid expansion in New York, PrEP prescriptions among Medicaid receipts increased (27); this suggests that for many key populations, insurance coverage remains a barrier to uptake of PrEP services. In this analysis we found that eight of the top 20 states for new HIV infections chose not to expand Medicaid. The South accounts for most new HIV diagnoses among cisgender women (50%), yet seven out of 14 states continue to opt of adoption of Medicaid expansion (Medicaid

TABLE 3 PrEP financial support programs.

Location	Program name	Application criteria (location, income, insurance)	Benefits
National	Gilead Sciences Advancing Access Patient Assistance Program	Income at or below 500% FPL Uninsured or underinsured	Co-payment assistance, reimbursement support, and patient assistance programs
National	Gilead Advancing Access Cost Sharing Assistance Program	Income at or below 500% FPL Uninsured or underinsured	Covers prescription costs for Truvada and Descovy
National	The Patient Advocate Foundation	Reside and receive treatment in the U.S. Income at or below 300% FPL Accepts all insurance, must cover pharmaceutical products	Maximum annual assistance: $7,500 to cover the costs of clinical visits, co-insurance, and deductibles.
National	Ready, Set, PrEP	Reside in the U.S., including tribal lands/territories No income eligibility requirement, For individuals who lack prescription drug coverage	Provides free, oral PrEP medication
National	Patient Access Network Foundation	Reside in the U.S., including territories, Income at or below 500% FPL Medicare insurance with prescription benefit	Maximum annual assistance: $3,600 to cover the costs of out-of-pocket medication costs, co-pays, and health insurance premiums
National	My Good Days	U.S. Social Security number required, receive treatment in the U.S. Income at or below 500% FPL Medicare, or Military Insurance	Maximum annual assistance: $7,500 to cover co-pays
National	ViiV Connect	U.S., DC, and Puerto Rico Income less than 500% FPL Not eligible for Medicaid/Mi Salud; no prescription drug coverage. Have Medicare Part B, D, or Advantage Plan, and spent $600+ on out-of-pocket prescription expenses that year	Provides free, long-acting injectable PrEP
Telemedicine	Mistr	Uninsured or underinsured men who have sex with men	Free provider consultation, laboratory tests, PrEP prescription
Telemedicine	Sistr	U.S., DC., and Puerto Rico. Uninsured or underinsured women	Free provider consultation, laboratory tests, PrEP prescription
District of Columbia	DC Health Drug Assistance Program	DC Metropolitan Area Resident Income at or below 500% FPL Have insurance Provider declaration of high risk for HIV infection	Provides PrEP medication
New York	PrEP Assistance Program	New York Resident Income at or below 500% of FPL Uninsured	Covers costs of clinical visits and lab testing; does not cover cost of PrEP medication
North Carolina	Western North Carolina AIDS Project	Uninsured or underinsured	Provides copay assistance and PrEP medication at a discount, or for free depending on eligibility
Arkansas	AR Care	Uninsured	Maximum annual assistance: $2,5000 to cover the costs of clinical visits, and prescriptions
Massachusetts	PrEP Drug Assistance Program	Live in Massachusetts Income at or below 500% FPL	Covers out of pocket costs for those with health insurance. Covers the full cost of PrEP for uninsured.
Illinois	Illinois PrEP Assistance Program	High risk for HIV infection per CDC guidelines	Client navigation for PrEP services: Education, Medication Access, provider referrals, enrollment into payment assistance programs
Tennessee	AIDs Drug Assistance Program	Tennessee State Residency Income at or below 400% FPL	PrEP medication and insurance financial assistance

coverage under expansion in North Carolina began on December 1, 2023) (18). In 2020, the PrEP-to-demand ratio for cisgender women in the South was twice as low as in other regions, despite having the highest number of cisgender women PrEP users. This suggests a significant unmet demand for PrEP among cisgender women in the South (19, 28).

This is not surprising, as individuals at high risk for HIV may not have insurance coverage and therefore not be able to access prevention

services; this is further complicated by barriers related to cost and access to a prescribing provider.

PrEP cost and prescriber requirements

PrEP cost and accessibility remain key barriers to acquisition and retention in care for individuals at high risk for HIV infection. Under the Affordable Care Act, PrEP medication, clinic visits and associated laboratory tests are free under most insurance plans; without insurance, however, the totality of cost is in the tens of thousands of dollars per year. We summarized the national level programs available to cover the costs for uninsured individuals, as well as those insured with other gaps in coverage. Only six of the included states in this analysis have established additional financial support programs to cover the costs of PrEP and associated clinic and laboratory costs; all but one of those states is a Medicaid expansion state, further highlighting the gap in financial support for individuals in non-expansion states.

Currently any licensed prescriber can prescribe FDA approved formulations of PrEP, regardless of specialization status in infectious disease or HIV medicine. Despite this, studies report limited knowledge, prescribing and insurance coverage concerns, and discomfort among physicians as barriers to providing PrEP to their patients (29–31). Primary care facilities may be the most appropriate entry point for otherwise healthy individuals at high risk for HIV, and yet there remain barriers to access to providers willing and comfortable prescribing the medication.

Provision of HIV prevention services at the pharmacy represents one approach to bridging the gap to PrEP initiation, as pharmacies remain much more accessible to the general population than other health care touch points; it also eliminates an additional stop in the care continuum, as patients can complete PrEP screening and pick up their medications in the same location. Under new PrEP expansion programs, pharmacists can order an HIV and other baseline testing requirements for PrEP initiation, and then schedule a consultation for counseling and initiation of PrEP upon receipt of the results. Pharmacist-prescribed PrEP is often limited to a 2–3-month supply, after which a patient would require a prescription from a non-pharmacist, license provider; this process may facilitate a more accessible and rapid initiation process until a relationship with a longer-term provider can be established.

A recent scoping review (32) was conducted discussing pharmacy-based interventions to increase PrEP use in the United States; the authors report strong support among patients for pharmacist prescribed PrEP, provided a recommendation for greater collaboration between pharmacists and providers in HIV prevention, and evaluation models using collaborative practice agreements that show promise for PrEP initiation in pharmacies (32). Randomized control trials and comparisons of PrEP initiation between states with and without pharmacist prescribing authority need to be conducted to evaluate the impact of these policies. This data demonstrates potential for pharmacy-initiated PrEP to bridge an accessibility gap for people at high risk of HIV.

Limitations

This review has limitations. All policies reviewed took place in the United States and its' territories. While the dynamics of sexual and reproductive health policy that apply in the United States are particular, the effects of policy and insurance-based barriers to PrEP, emergency contraception and HIV testing are not limited to this setting. Additionally, only a subset of U.S. states were analyzed; while included states represent those with the highest burden of HIV infection among cisgender women, a broader set of state policies may improve generalizability.

Conclusion

Cisgender women and birthing individuals remain a key population for HIV prevention and other SRH programming, especially following the U.S. Supreme Court's decision to overturn Roe v. Wade and the subsequent implementation and enforcement of abortion laws starting in 2022.

Limited Medicaid coverage presents a substantial barrier to the extensive implementation of PrEP, as potential users frequently cite the financial burdens related to medication costs and healthcare visits as justifications for abstaining from adoption or maintenance of the PrEP regimen. The lack of health insurance continues to impede service utilization among individuals of reproductive age; therefore, further alternative initiatives such as pharmacy access and telemedicine are required to address the financial and accessibility disparities that continue to exist for this population segment. HIV testing mandates in emergency settings may additionally improve accessibility for screening and reduce associated stigma. Finally, revising prescribing requirements for key clinical areas may facilitate an important workforce expansion that will also support accessibility.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: not applicable – CDC Atlas Data and Public Policy were used for this study.

Author contributions

AC: Conceptualization, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing. KB: Conceptualization, Supervision, Writing – review & editing.

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Understanding inequalities in the coverage of adolescent sexual and reproductive health services: a qualitative case study of the selected regions of Zambia

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Introduction: Despite substantial investment in improving healthcare among adolescents in low- and middle-income countries, barriers to access and utilization of services persist, especially to sexual and reproductive health (SRH) services. In response to adolescents' health service needs due to their vulnerability, interventions aimed at improving access and utilization of sexual and reproductive health services have been implemented in specific regions of Zambia. To highlight progress in the access and the overall delivery of services in Zambia, in the wake of a system-level funding mechanism, this paper aims to understand the accessibility, availability, acceptability and quality (AAAQ) of health services provided to young people.

Materials and methods: In a qualitative case study, 48 discussions- 32 individual interviews with stakeholders and 16 focus group discussions, consisting of 128 male and female adolescents were conducted in six districts from Eastern, Southern and Muchinga provinces of Zambia. Interviews were audio-recorded, recordings transcribed verbatim, and transcripts were analysed using deductive thematic analysis, using the AAAQ framework and Atun's framework on integration, as a guide to reporting the findings.

Results: We found that adolescents knew of and had access to common commodities and services- male condoms, health education and HIV counselling and testing. However, availability was affected by access-related barriers such as frequent stock-outs and insufficiently trained healthcare providers. In addition, accessibility was more restricted during the COVID-19 pandemic lockdown and compounded by the low acceptability of SRH service among adolescents across all contexts. This led to the use of alternatives such as herbal medicine and maintained common myths and misconceptions. The

Abbreviations
AAAQ, availability, accessibility, acceptability, quality; ANC, anti-natal care; ART, ante retroviral therapy; ASRHR, adolescent sexual reproductive health rights; AYP, adolescents and young people; BeMONC, basic emergency obstetrics and newborn care; CHW, community health workers; DHD, district health director; EmONC, emergency obstetric & newborn care; eMTCT, elimination of mother to child transmission; HCP, health care provider; MCH, maternal and child health; PAC, post-abortion care; PNC, post natal care; RMNCAHN, reproductive, maternal, neonatal, child, adolescent health and nutrition; SGBV, sexual gender-based violence; SIDA, Swedish International Development Cooperation Agency; SMAG, safe motherhood action groups; SRH, sexual reproductive health; UHC, universal health coverage.

overall quality was marred by the lack of dedicated spaces for adolescent health services and the lack of information, education and communication (IEC) materials in some spaces.

Conclusion: While it was noted that some services were available for adolescents in all the study sites, numerous barriers inhibited access to these services and had an impact on the quality-of-service provision. With the added restriction to SRH service asses for young people, due to the low acceptability of adolescent SRH service use, the overall integration of adolescent SRH interventions into routine service provision was low and can be improved by targeting contextual barriers and maintaining best practices.

KEYWORDS

acceptability, accessibility, availability, quality, adolescents and young people, sexual and reproductive health, human rights framework

Introduction

Despite efforts to accelerate progress in the coverage of essential health services, some populations remain "left behind" (1). Attaining the United Nations 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs) requires protective laws, policies and practices that promote non-discrimination, equality and non-violence towards vulnerable and key populations -sex workers, gay men and other men who have sex with men, transgender people, people who inject drugs, indigenous populations, internally displaced populations, people in prisons and other enclosed settings and *adolescents and young people*, and other people that have been left behind (2).

The goals of Universal Health Coverage (UHC) are reinforced by the need to provide prevention, promotion, treatment, rehabilitation and palliative services to all who need them (3). In addition, providing sexual and reproductive health (SRH) services to all, including adolescents and young people (AYP) remains a major priority for achieving global UHC (4), and this is necessary to "ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes by 2030" -SGD target 3.7 (5).

Adolescent Sexual and Reproductive Health and Rights (ASRHR), according to the World Health Organization (WHO), is "a state of complete physical, mental and social well-being, not merely the absence of disease and infirmity, in all matters relating to the reproductive system and its functions and processes specifically applied to adolescents" (6). Across the globe, more than 16 million young women (15–19 years old) residing in low- & middle-income countries give birth yearly (7). This trend worsens in the sub-Saharan context, where the prevalence of teen pregnancy is as high as 18.8%, and SRH issues remain highly contested, particularly concerning AYP (8). This usually results in barriers to access and utilization of SRH services by AYP, rooted in health worker bias, the lack of willingness from health workers to provide services, socio-economic constraints, or the lack of knowledge about sexual health needs (9). This has left AYP more vulnerable to "illegal" or "unsafe" options (10) and other negative health consequences such as the unmet need for contraception, harmful gender inequalities, high sexual gender-based violence (SGBV) rates, and alcohol and drug use disorders (11).

The Zambian government committed to improving adolescent health through policies such as the SRH focused on Reproductive, Maternal, Newborn, Child and Adolescent Health and Nutrition Communication and Advocacy Strategy 2018–2021, which aimed "to effectively target and serve adolescents and youth with quality accessible sexual and reproductive health information and services in and out of school" (12). These reinforced the need to protect young people from the negative effects of poor access to SRH services and an overall improvement in health status. However, coverage remained lacking as studies have shown variations in the availability, accessibility, acceptability and quality of interventions-negative healthcare workers attitudes, low access to services, poor infrastructure for adolescent SRH services, low contraceptive uptake, increased risk of contracting HIV as STIs, among others (13–16).

The SIDA interventions

Within national level guidance, and to increase the availability and readiness of quality, increasing demand and uptake of physically, culturally, and financially accessible health services, the Zambian Ministry of Health, with support the from Swedish International Development Cooperation Agency (SIDA) supported SRH and nutrition services in four provinces of Zambia. SIDA-supported evidence-based interventions aimed to strengthen the health system at the national and sub-national levels as necessary to provide an enabling environment for effective reproductive, maternal, neonatal, child, adolescent health and nutrition (RMNCAH&N) service delivery. This was done by; (a) recruiting additional health workers; (b) capacity-building through training of health care providers, including provision of incentives for health care providers at various levels; (c) rehabilitating or constructing essential buildings; (d) purchasing different types of materials in the provinces; (e) key demand-creation activities for users; (f) several activities at the national level to contribute towards health systems strengthening; and (g) forming a steering committee to support monitoring of

interventions across contexts. SIDA supported system-level interventions, which were all evidence-based interventions (EBI). Thus, no new interventions was rolled out, however, funding was made more available for existing interventions. More information on the nature of SIDA funding support and the interventions is available elsewhere (13, 17).

In understanding the effectiveness of investment in the health of a marginalised group such as AYP, equity becomes a key consideration (18). As such, the Human Rights-Based AAAQ Framework illuminates the short and long-term impact of such interventions, in trying to understand how young people claim their right to health care (19). Additionally, Atun's Integration Framework is useful in exploring the nature and extent of integration of the interventions into routine healthcare provision-speaking to questions of sustainment within the system. While there is no commonly accepted definition of "integration", Atun et al., propose that "*(…) the adoption and diffusion of new health interventions and the extent to which they are integrated into critical health system functions will be influenced by the nature of the problem being addressed, the intervention, the adoption system, the health system characteristics, and the broad context*" (20).

Thus, integration can be influenced by the nature of the (i) problem being addressed, (i) the intervention, (iii) the adoption system, (iv) the health system characteristics, and (v) the broad context. This paper, therefore, aims to assess the availability, accessibility, acceptability and quality of care of adolescent SRH services in selected contexts of Zambia, and to ascertain the extent to which the intended interventions strengthened the health system as necessary to provide an enabling environment for effective RMNCAH&N service delivery, especially for young people. Understanding the inequalities of SRH services among adolescents is crucial for increasing access to services and utilization, and for empowering young people with their right to health. This is important due to the large number of adolescents in Zambia (60%) and the added benefit of investing in the population at this time of their lives.

Materials and methods

Design

This paper uses a qualitative descriptive case study design (in a constructionist paradigm), answering the "why" and "how" questions in the context of identified inequalities in the coverage of services (18), in some selected low-performing and well-performing districts with a focus on availability, accessibility, acceptability and quality of care (19) for RMNCAH&N interventions. This study design is suitable for understanding circumstances surrounding the uneven coverage of services for adolescents, in the real-world setting.

Study setting

The study setting was selected districts from Eastern, Southern and Muchinga Provinces of Zambia. These districts included Choma, and Livingstone in the Southern province, Chinsali and Nakonde in Muchinga province, and Chipata and Mambwe in the Eastern province. The districts were purposively selected among the districts implementing RMNCAH&N interventions with support from SIDA in the three provinces, as guided by program implementers. Preliminary analysis of national-level coverage revealed that one of the provinces reported higher RMNCAH&N indicators, while another reported lower RMNCAH&N coverage indicators. The third province reported both high and low coverage indicators. Additionally, the analysis also showed improvements in rural settings, and poorer health outcomes in the urban areas. This analysis informed the selection of districts in each of the provinces. Thus, participants were drawn from the communities within the catchment areas of one rural and one urban public facility in each of the selected well or poor-performing districts.

Study population and characteristics

The views expressed in this study were drawn from discussions with adolescent males and females, frontline healthcare providers, community health workers, traditional leaders and program staff at provincial or district health offices. Adolescent boys and girls were aged between 10 and 19 years, from whom consent (and assent where necessary) was obtained/provided and were living within the communities at least for a year preceding the interviews were enrolled. Within the community, the leaders interviewed included headmen or chiefs within the catchment area of the health facility, as well as civic leaders in the districts.

On the health care system side, frontline health care providers providing RMNCAH&N services at the health facility were enrolled; preferably those who received additional training in the Elimination of Mother-to-Child Transmission of HIV (eMTCT), Post-Abortion Care (PAC), Emergency Obstetric and Newborn Care (EmONC), and Basic Emergency Obstetric and Newborn Care (BEmONC). Program staff- individuals involved in the management and coordination of the RMNCAH&N interventions, and preferably, those who had been working in their capacities since the first year of the project were included as they support the activities of the frontline healthcare workers. At the community level, Community Health Workers (CHWs), who included those volunteering in RMNCAH&N services, as well as CHWs supporting RMNCAH&N services at the health facility or in the community; and were living within the community of interest for not less than a year were enrolled into the study.

Recruitment of participants

Community Health Volunteers (CHVs), mainly the Safe Motherhood Action Groups (SMAGs), facilitated the recruitment of participants for the study. Other CHWs from the Neighbourhood Health Committees aided recruitment. The SMAGs were trained to support women during their pregnancy and help to disseminate information about pregnancy, childbirth

and family planning to create awareness of maternal and newborn health services, including adolescent health and nutrition. The SMAGs and CHWs interact with and live within the communities, as such, they were more helpful in identifying study participants particularly those that were not easy to locate by the research teams. The study team discussed the inclusion and exclusion criteria with the community volunteers, and they helped the study team to identify the required respondents.

Sampling considerations

A heterogeneous selection strategy of participants of at least four (4) focus group discussions (FGDs) with adolescent males and females was drawn in each district (total of 16 FGDs). In addition, one (1) interview with a community leader and four (4) interviews with programme managers/health workers/community health volunteers were done in each sub-region (total of 32 interviews). Table 1 summarises the list of interviews that were conducted.

Data collection

Data was collected in November 2020. All discussions-in-depth interviews (IDIs), key-informant interviews (KIIs), and focus-group discussions (FGDs) were conducted in private areas to ensure privacy and confidentiality and using semi-structured discussion guides to explore availability, accessibility, acceptability and quality of services. The discussion guides contained questions about family planning, STIs/HIV/AIDs prevention and treatment, antenatal care, nutrition services and youth-friendly services. The FGDs each included 8 participants, and discussions were held in locations agreed upon by the participants, within the communities and outside health facilities. The seating arrangement of participants during the FGDs was U-shaped to ensure interaction and for the moderator to easily observe everyone.

All interviews and discussions were conducted in English or the common local languages (such as Nyanja, Tonga or Bemba) in each region visited, or a combination of two or three of these. If participants gave consent, the interviews were digitally recorded. All interview guides (initially in English) were translated into Bemba, Nyanja and Tonga independently. To achieve data triangulation, interviews were conducted with different groups of participants from those included in the FGDs, using a semi-structured discussion guide. Both FGDs and IDIs were used for cross-verification and complementary purposes.

Data management and analysis

The audio recordings of interviews were transcribed verbatim from either of the local languages used and then translated into English by professional transcribers/translators. A thematic analysis was used to put into context the findings of the study (21). A few (10%) transcripts were thoroughly read for familiarization and re-read by two independent researchers to develop an initial coding scheme. The codes agreed upon were organized to create categories or sub-themes and later main themes. Thereafter, all the transcripts were transferred into NVivo version 11 and were coded. The coding process allowed for the identification of emerging themes and subthemes. Finally, a report of the relationships between themes was presented.

Quality control & data storage

The tools used to collect the data were pre-tested before data collection to identify potential deficiencies and to ensure consistency in understanding the research aims among data collection teams. All researchers involved in the study went out to one district (not one of the study districts) to collect data using the tools, and this process was discussed during a training session. All the research assistants were trained in data collection and familiarised themselves with the tools. The community mobilizers were also trained to screen the participants to confirm that they met the eligibility criteria. About ten per cent of the recorded interviews/discussions were transcribed verbatim in the local languages used and then translated into English by research assistants. Some transcripts (10) were randomly selected and verified by a back translation into Bemba, Tonga or Nyanja for accuracy. Transcripts that were not back-translated were reviewed by listening to the original voice recordings to ensure that they retained the original meanings after translation. All the data collected and the related files including field notes were stored on password-protected hard drives and all access to the data was restricted to the project staff.

TABLE 1 List of participants in the study.

Type of participants	Approach[a]	Respondents (age range)	Number of sessions/participants per session	Total participants
Adolescent males and females	FGDs	Males (10–19) Median age-17	8 sessions/8 participants	64
		Females (10–19) Median age-16	8 sessions/8 participants	64
Key informers	IDIs	District or Provincial Office	12 sessions/1 participant	12
Frontline healthcare providers	IDIs	Programme managers, implementers	8 sessions/1 participant	8
Community health workers	IDIs	SMAGs, counsellors, treatment supporters	8 sessions/1 participant	8
Community leaders	IDIs	Chiefs or headmen	4 sessions/1 participant	4
		Total	48	160

[a]Data collection approach; (IDI) in-depth interview or (FGD) focus-group discussion.

The data will be stored for a period of up to five years from data collection, after which it will be destroyed.

Ethical considerations

Ethical clearance for the study was granted by the University of Zambia Biomedical Research Ethics Committee (REF 1236-2020) and the National Health Research Authority. The researchers administered informed consent, conducted interviews and facilitated/moderated discussions in private places to ensure confidentiality. Personal identifiers such as names of participants were not recorded in the audio or any other documentation. For participants below the consenting age, both consent from parents and guardians and assent for them to take part in the study were sought. It was well noted that younger participants lacked agency and were at risk of being coerced into taking part in the study, thus, the assent process was emphasised to the researchers who administered it. In addition, the researchers' power and positions were actively addressed during training, to reduce biases.

Findings

This paper aims to assess the availability, accessibility, acceptability and quality of care of adolescent SRH services in selected provinces in Zambia, in line with the human rights-based AAAQ framework (19). In this section, we unpacked each of the availability, accessibility, and acceptability constructs (with quality included in each of them) to provide highlights of some of the conversations with intervention implementers and adolescents.

Availability

Available services

Participants described the available services for adolescents with caution because it is a sensitive subject to debate. Among the services mentioned were youth-friendly services that encompass condom distribution and contraception, sexual health education, dedicated ART services and a deliberate effort to support girls to go back to school after childbirth. Specific youth-friendly services reported to be available were antenatal care, family planning, treatment for STIs, HIV testing and counselling. The MCH Coordinator from a well-performing district said:

> "(…) we provide almost all the services, such as antenatal care because we separate [adolescents from the adults], adolescents have their own day for antenatal, family planning, HIV testing. They also go out to sensitize the community; they visit schools to sensitize on adolescent activities or services that are offered from the clinics (…)"
>
> [MCH Coordinator from a well-performing district].

Health provider as a barrier to availability

While the youth-friendly services were advocated for by providers, the fear of creating an access barrier in case the adolescents recognized the coordinator as a parent as well, a young healthcare provider was assigned to coordinate the services for adolescents, while the MCH coordinator remained to oversee the implementation. According to an MCH Coordinator, from a well-performing district,

> "(…) when they come for family planning and they find me who is the friend to the mother, do you think this fourteen-year-old will be free to get family planning. She will think that I going to tell her mother (…). Even here we have got an adolescent focal person … someone who looks younger because I used to coordinate but I said I think I need to shift to a younger man to handle the services…I am just a coordinator am not an adolescent, I don't face adolescents in the office (…)"
>
> [MCH Coordinator, from a well-performing district].

Knowledge of contraceptive methods

Knowledge of methods was linked to what was available. When asked if they knew any contraceptive methods, adolescents in rural low—performing districts mentioned injectables, Intrauterine Contraceptive Devices (IUCD) [copper was most prominent] and "morning-after" pills [emergency contraception]. Health education activities were reported in some form or the other, and in the rural and urban districts of the low-performing region, knowledge about a variety of FP methods and other SRH services was still widespread among the adolescents.

> Respondent: Me, I heard that there are oral, oral meaning, (Pause) Tablets, Pills, then there is also long-term service, like *Jadelle* for 5 years and that one for 3 years (…).
>
> Respondent: (…) *Depo*, there is for 2 months and 3 months. Again, they give a condom as part of family planning that prevents not only pregnancy but also STIs (…)
>
> Respondent: …there is the one for pills, the family planning and that one for injections for years and loop, and condoms.
>
> [Adolescent girls, urban, low-performing district]

Usage of contraceptive methods

Usage of methods was linked to what was available. In a high-performing province, adolescents were more inclined towards using condoms as a form of Family Planning (FP). In a rural subregion, a health facility in charge reported that they had dedicated days when they attended to adolescents living with HIV and accessing ART. Community leaders were not only involved in sex education but also advocating and encouraging girls who left school due to pregnancy to go back. A community leader in a rural well-performing district explained:

> "…in my case, I call maybe two teachers, community members and girls dropped out of school because of pregnancies. The teachers advise them to go back to school since they had

> given birth and their children have grown up (…) so they are advised and even inspired by examples of people with children who went back to school (…)"
>
> [Community leader in a rural well-performing district].

Accessibility

Accessible methods

In framing accessible adolescent health services, this section describes how the participants highlighted only what they understood in terms of health education activities, condom distribution and access, HIV counselling and testing. When considered against the narratives from the MCH coordinators, the DDH and health care providers, it is possible to contextualise them as barriers and facilitators to accessibility. Adolescents accessed family planning products such as condoms from the health facilities as well as shops: a female adolescent from a well-performing urban district said:

> "We have no challenges. People are into groups, and they meet separately to combat the distance issue. Condoms are given away. Personally, I have collected condoms at this health facility. Others refuse to get condoms due to fear of being looked down upon".
>
> [Female adolescent from a well-performing urban district].

Other reproductive health services accessed by adolescents across contexts included HIV counselling and testing as well as cervical cancer screening.

Barriers to access: healthcare workers as barriers

However, some healthcare providers were still interrogating and discouraging youths from accessing condoms or contraception or even other reproductive health services such as HIV counselling and testing. While healthcare providers meant to encourage the treatment of both partners, they also prevented the use of services for young people who were proactive but did not follow all their guidelines. A female adolescent from a low-performing urban district said:

> "On my part, I came to test for HIV. They said that I should come with my boyfriend. That is when I asked what [happens] if I did not have a boyfriend. [They asked if it] is he who has gotten sick or me? Then they said just in case I was having sex with my boyfriend while I had the disease, we [healthcare providers] do not know who gave it to you. Then I said now what if my boyfriend is in Lusaka and not here, they said you should look for another boyfriend and come with him".
>
> [A female adolescent from a low-performing urban district]

Herbal medicine as an alternative to restricted access

Regardless, adolescents had some access to information on the types and benefits of different contraception methods. Adolescent girls from low-performing rural areas described family planning in the context of the prevention of pregnancy and not diseases. However, information on the use of herbal medicine for family planning was equally mentioned as it was passed on to them in the community. Sexuality education was also taught in schools as reported across contexts. An adolescent male from a low-performing rural facility said: "*We learnt it from school, people used to come and teach us how to use family planning and how to get it at the clinic*". A female adolescent from a low-performing urban district mentioned other sources of information and services related to family planning. She said

> "(…) I was also taught at church (…) and even also hear from our friends in the community. Information is also accessed from radios at home, TVs and even phones (three-quarters of us have phones) of course it is not like these things are hidden, we can find them anywhere even on social media, on Facebook we do find these things".
>
> [Female adolescent from a low-performing urban district].

Other young people noted that sex education was not taught in their schools.

In the low-performing rural and urban regions, numerous barriers to access were noted. Most facilities are understaffed, and family planning services were only available on certain days, alongside other women in the community. While adolescents felt that, the community-based activities were helpful for most young people, particularly those who were scared to visit the facility or lived far away from it. A female adolescent from a low-performing rural district said: "*It can be easy and nice because there are some youths who feel shy to come to the clinic, so if the friendly corner was brought nearby, it can be better*". However, young people still lacked sufficient agency to walk to the health centres to access contraception despite the use of peer educators and visiting the communities by peers was a welcome solution.

> Respondent: the challenges are not there but some people are embarrassed that they will see me that I also come to get condoms. Others do not feel embarrassed, and it is very easy for them to get condoms.
>
> Respondent: I would say that we used to face challenges but now it is different because the peer educators go into communities and people are educated from there. In the past people used to be scared of family planning. You know people are difficult some would say it is good and some would say it is bad. I would say information has spread in the community because of doing door-to-door visitation through role-plays.
>
> [Adolescent males, low-performing rural district]

Routine stock outs prevented access to commodities for young people. In some rural health facilities in the low-performing

context, there were stock-outs of both male and female condoms and contraceptive pills. The female adolescents reported that, apart from stock outs, there were no educational materials for adolescent peer educators to use when teaching their friends: Occasionally, the demand for condoms increased during special events such as weddings and other ceremonies, and the supply was insufficient. An adolescent male from a low-performing rural district said:

> "No, the population here is big so we need more male condoms so that they are enough for everyone. Like here in the village in case there is a wedding in the neighbourhood village in the night we peer educators do carry condoms to distribute at the wedding to whoever wants them. The number of condoms should be increased".
>
> [Adolescent male from a low-performing rural district].

The lack of dedicated time and spaces for adolescent service provision was a common theme across all contexts. The lack of privacy left some of the adolescents feeling exposed to the rest of the community. This situation was worse for adolescents living with HIV as they sought refills for ARVs, which were done openly. One male adolescent from a low-performing rural district said: "*There isn't any privacy and when it's time to get the medicine you enter in a room for those getting and everyone else sees you when you enter that room. So some people feel shy*". The COVID-19 pandemic compounded these challenges, as adolescents reported experiencing challenges with access to condoms because some of the interventions undertaken to improve access were abandoned. A female adolescent from a well-performing rural district said:

> "Over the distance issue, they should be sending some workers in the field to make it easy for those far away to access the services. Like in February [2020], many school pupils wanted to have access to condoms so they formed a group and they used to come and educate us. But after the breakout of Covid-19, the groups were abandoned".
>
> [Female adolescent from a well-performing rural district].

Acceptability

Barriers to acceptability- contraception seen as linked to promiscuity

Although services were available in one way or another, dynamics were at play that could impede acceptability- the use of alternative medicine, the link between contraception and promiscuity, fear of infertility, religious views and being aware of reproductive health and rights. Adolescents narrated that there were herbal medicines that could be used to prevent pregnancy. A male adolescent from a rural low-performing district said: "(…) *the herbal medicines they use work in a way that a woman who gives birth is only given that medication after 6 months to prevent pregnancy in a short period before the other baby has grown.*" Adolescents from this context also noted the ease of interaction with fellow young people when accessing the services. A female adolescent from a rural low-performing district said:

> "(…) when you come to the clinic you pass through first the peer educators, they counsel you then they take you to the doctor where there is privacy who tells us that the family planning, I have given you does not prevent diseases but pregnancy".
>
> [Female adolescent from a rural low-performing district].

Engaging community leaders shaped acceptability

However, even in the well-performing district, community leaders aimed to uphold their "good" reputation in their villages by regulating access to family planning services for adolescents and avoiding being labelled as supporters of prostitution. This was noted to restrict access to services for adolescents. In the urban low-performing district, the district health director reported the need to increase the acceptability of services in his region. When asked to provide an overview of the services in his district, he said:

> "…I'll start with the adolescents, I think, we have about 6 health facilities which are championing the youth-friendly corner (…). To me, if we were to do well, I think if we were to cover everyone that would be much better because these youths are coming from all over [the district]. That is one of the issues to address concerning adolescents (…)
>
> [District Health Director, urban low-performing district].

Community members from low-performing urban districts noted the link between family planning usage among women and promiscuity. The boys recalled being more accepting of their condom use, compared to the girls, -who were labelled as "prostitutes" when they tried to access the services or youth-friendly meetings. Young people said the community members felt that they were too young for family planning and sexual and reproductive health teachings. A young female from a low-performing rural said: "*Us* [the youth] *we are not supposed to get family planning because we will have that thought that 'I am on family planning' and start living careless and end up getting infected*". A man from a rural well-performing district also said adolescents who accessed condoms and contraceptives were labelled as "loose" and indulged in careless sexual activities.

Fear of infertility as a barrier

It was common for adolescent girls from a low-performing facility in an urban district to avoid contraception until they had a child out of fear of contraceptive use-related complications and infertility when they finally decided to have babies in future. It was therefore warranted for healthcare providers to seek their

parental consent before the provision of services, to protect their future fertility. Although this was the main justification, consent was also sought from partners of married women- creating a barrier to use. One male respondent advocated for partner consent by saying:

> "(…) everything has precautions which we should follow and just as they said that if someone comes without having to consult their husband to say am going to do this, there might be a conflict in the house, so everything has an advantage and a disadvantage".
>
> [Adolescent male low-performing facility in an urban district].

In addition, future infertility was tightly woven with labels of promiscuity, as though it was the fate of all users of contraception. A female adolescent from a well-performing rural district said: "*(…) they usually discourage us by saying we will never conceive, saying if we use it, we will start having sex with different men as a result in the future will never bear children that is what they are saying in the community*". Parents did not support the use of family planning.

Restriction of acceptability due to marital status

Family planning was only permissible for married community members, and adolescents and unmarried individuals were shunned for using this service. Women from low-performing urban districts debated the provision of contraception to young women and girls. One woman was not happy about sharing scarce commodities with young people, who were not even supposed to be using them. She said:

> "Life is difficult, the life we are leading these days is hard, you can't give birth to a lot of children that my sister or my brother will keep for me, it finished that is long gone, you have to know the number of children you will give birth to (…). Why allow children to get family planning, they are allowing them to go and get HIV, because nowadays when we look, at long ago there were no children at family planning, they wanted those who are married They would even ask you, but nowadays why are you allowing school going children to be given family planning?"
>
> [Adolescent female, low-performing urban districts].

Restrictions related to religious and traditional beliefs

While there was more access to contraception for young people, the community was not very happy about this. While very few religious sects or groups opposed the use of family planning, Christians were against the promotion of contraception use among the youth. A young man from the low-performing urban district in Muchinga narrated how the use of contraception was an act of going against his teachings as a person of Christian (catholic) faith because he knew he was not supposed to use contraception at all…

> "(…) as Catholics we have discussions over such issues of family planning, and they teach us that Catholics are not allowed unless if they have seen that in having a lot of children they might risk their life… that is when they are allowed (…)"
>
> [Young man from the low-performing urban district].

Another male adolescent from a low performing rural district said: "(…) traditional beliefs of the elders are that they should be an increase in population and hence they don't encourage family planning". Despite all these restrictions to acceptability and access barriers, young people mentioned that they were aware of their right to access services and the benefits of these services.

Discussion

The findings of this study were described in the context of availability, accessibility, acceptability and quality of care of adolescents SRH services in selected provinces of Zambia. The AAAQ context helped to understand the value of a holistic approach to providing SRH services for adolescents in Zambia and similar settings (22) and taking into consideration the challenges and opportunities to provide interventions that translate into behaviour change (23). Generally, for the interventions explored in this study, efforts were made to increase the availability of services across the continuum of care and contexts. Peer providers were engaged to increase access to information and services, particularly the distribution of condoms and dedicated ART spaces (24). In the well-performing districts, community leaders were engaged to increase demand for these services and to encourage young people to go back to school. Such efforts were reported as effective, although the actual availability of trained sensitized and "youth friendly" healthcare providers and necessary commodities were not always available on demand. In addition, engaging community leaders to increase demand sometimes restricted access instead, due to the leaders' other obligations in the community such as upholding the good behaviour of young people.

Therefore, it has been reported that what must be considered are young people's pathways to seeking services; and the specific barriers they face before getting to the services while receiving services, and after leaving the service delivery sites (25–27), which was observed and reported to be a challenge in the selected sites in this study. It has been recommended in similar settings to pay attention to the perceptions and needs of young people along with the development of policies, services, and programs that address these gaps in service delivery (25). Studies have indicated that attitudes can be changed through the implementation of diverse strategies, in this case, to effectively train healthcare providers in delivering adolescent-friendly health services that prioritize the individual. These strategies include values clarification training, relationship-building practice sessions, and the appointment of champions to drive transformative change (28).

Access to services was reported, as young people cited receiving information from schools, at the health facilities and within their communities- through a variety of actors such as teachers, healthcare providers, community members, and peer educators who were affiliated with health facilities. It was noted that well-performing contexts reported more activities while low-performance regions reported erratic provision of services, frequent stockouts, lack of trained healthcare providers and challenges with funding (29, 27). Thus, barriers to access were noted to lead to alternative sources such as herbal remedies and unauthorised contraception options which can be very unsafe (11).

Acceptability was generally low as most community members felt young people were not supposed to access these services, perpetually widening the "taboo gap" as suggested by Nesamoney et al. (30). In many African contexts, particularly in the sub-region, there is a prevalent unease when it comes to discussing sex-related topics with young people. This discomfort is often rooted in the fear of being misinterpreted as condoning or promoting sexual activity (31, 32). The absence of dedicated spaces and time for young people posed challenges to the delivery of services in certain contexts. Even when young people managed to access available spaces, they often faced the fear of being stigmatized as promiscuous, concerns about infertility, and apprehension about potential side effects. The fear of infertility poses a significant and longstanding barrier to contraceptive use, requiring specific attention to promote the uptake of contraceptive methods among young people (33, 34).

Consequently, many young people refrained from utilizing services, particularly contraception. Addressing this significant gap can be achieved by incorporating sexual and reproductive health (SRH) services within Safe Spaces, considering that young people are naturally drawn to these environments. By integrating SRH provision within Safe Spaces, the accessibility and attractiveness of these spaces can be enhanced for young individuals (35). Misconceptions about the efficacy of contraceptives and condoms have been linked to reduced acceptability and usage of contraception in other contexts too, without many interventions that target offsetting them (36).

Low acceptability also contributed to the rise in more private and acceptable alternatives such as herbal medicine. However, young people were aware of their right to use these services, but cultural norms and religious beliefs (37) contradicted these rights and reduced utilization. Other studies have suggested social accountability, as well as life skills-based education to respond to cultural barriers are suggested as potential solutions to increase the acceptability of highly stigmatized services, such as ASRH in most contexts, as suggested by this study (4, 38).

On the one hand, while the engagement of peer educators and community leaders were noted to increase the right of young people to access and utilize services, community values and beliefs continued to reduce this right, alongside other service-related challenges. On the other hand, it was also important to highlight the extent to which components of the interventions to increase SRH service utilization, according to Atun's framework, were shaped by the influence of: (i) the problem being addressed, (i) the intervention(s), (iii) the adoption system, (iv) the health system characteristics, and (v) the broad context—or integrated into routine adolescent health service provision and utilization.

It was a common perception that adolescents lacked access to services and faced challenges with availability and the low acceptability of adolescent health services, particularly, SRH services. A key indicator of these gaps is the high teenage pregnancy rates and negative health outcomes among young people. The interventions under discussion, AYFHS, were established in the early 90s, the system-wide intervention that has been rolled out and scaled up to all health facilities in the country (Adolescent Health Strategy, 2017–2021) (39).

According to the literature, the current funding intervention was rolled out at the district level in 22 districts of the southern and eastern provinces of Zambia, and all the 22 districts funded were non-randomly selected (13). However, the districts received the first funding disbursement meant for the initial implementation of the work plans in the fourth quarter of the first year due to some programme delays (13). While acknowledging that the Zambian health sector is hugely dependent on foreign assistance and external sources of funding, the delay in the disbursement of funds was significant (13). In addition, challenges with space accessibility, qualified human resources who may have positive or negative attitudes towards adolescents, and occasional stock-outs of commodities affected the implementation of these interventions. Feelings of lack of privacy, waiting times, and the lack of urgency when an individual is seeking information were cited as significant barriers to use, alongside fears of infertility, judgement, embarrassment and the lack of confidentiality and privacy, as corroborated by other studies (40–42). This points to some incompatibility of the interventions to the context.

Additionally, where young people failed to access or utilize services, alternative medicine was sought. In other places, these spaces have been modified, meeting under a tree, the use of peer educators under the supervision of trained HCPs. Also, the need to respond to increased demand during special occasions such as weddings and traditional ceremonies was mentioned by young people, like research findings on the need to adapt the provision of services during disruptions such as the COVID-19 pandemic (43). Some modifications to the interventions have proven effective in some contexts, while those that failed to innovate recorded poor health outcomes for young people. Social media interventions using the internet, newspapers or magazines, radio and television have proven effective in increasing demand for services (44, 45).

In consideration of the well-known service gaps in the health system, areas that had overcome shortages of trained, or even untrained healthcare providers still had challenges providing services and the quality of services was compromised. In addition, vast geographical areas are occasionally impassable. All these system-level barriers were also compounded by the COVID-19 pandemic, which restricted access to services and even healthcare providers as they were called to the frontline of the fight against the pandemic. Challenges of resilience during epidemics also question the extent of integration of AYFHS into the health system, suggesting more proactive consideration of these during system shocks (46).

Strengths and limitations

It was noted that firstly, there were inadequate representations of all stakeholders, although provider and users' perspectives were captured, and triangulation of data sources and methods (using both interviews and group discussions) increased the credibility and dependability of findings. The study included three broad contexts-high performing, low-performing and one that had a mixed picture. In addition, two subregions for each of the three contexts were included, as well as variation in gender and age of respondents, and this increased transferability. While more detailed findings can be presented on the topic in future research, the description of the contexts is limited, but the description of the methods and procedures is much more elaborate, ensuring dependability and overall validity (47, 48). In addition, as this paper is based on a qualitative study, it adhered to the Standards for Reporting Qualitative Research (SRQR) to improve transparency of all aspects of the research, thereby increasing validity (49). Finally, this work was conducted by a specialist in maternal and child health, a specialist in women's health, a specialist in epidemiology and biostatistics and a specialist in adolescent sexual and reproductive health. All researchers understood the subject well and were all experienced in collecting, analysing and managing qualitative research data. Future research should more actively include more adolescents and other stakeholders in the sample size and should investigate the barriers to adolescent service provision using adolescent-friendly service guidance from the WHO. Additionally, more should be included on clinic funding disbursements related to SRH service provision, engagement of peers in increasing access to services, and engagement of community leaders.

Conclusion

In addressing sexual and reproductive health from an SRH rights perspective, it is evident that progress has been made, although there is still much ground to cover. To bridge this gap and strengthen health systems, it is essential to focus on actionable recommendations that increase the acceptability of services across multiple actors. This comprehensive approach will significantly enhance service provision and utilization. One crucial recommendation is to foster multi-stakeholder collaboration, bringing together government agencies, NGOs, community leaders, and youth organizations. Through joint efforts, these stakeholders can work towards improving service acceptability and accessibility. Additionally, efforts should be made to secure regular funding, enabling sustained provision of services and overcoming barriers faced by some contexts.

Another critical aspect is addressing restricted access due to geographical distances. Contextually driven interventions tailored to specific areas can effectively reduce access barriers and improve service delivery. By implementing strategies such as mobile clinics, outreach programs, and telehealth services, healthcare can be extended to underserved regions. To further promote the SRH rights, it is important to engage in community engagement and education. This involves conducting awareness campaigns, educational programs, and community dialogues to combat stigma, dispel misconceptions, and garner support for youth-friendly services. Empowering young people through their active participation in decision-making processes and service design is also vital. By focusing on these recommendations, progress can be made in reducing access barriers, strengthening health systems, and upholding the human rights of young people in relation to their sexual and reproductive health.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by University of Zambia Biomedical Research Ethics Committee (UNZABREC). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

MM: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. A-NH: Writing – review & editing, Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization. MS: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. CJ: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frph.2024.1399289/full#supplementary-material

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Prevalence of mental disorders among young people living with HIV: a systematic review and meta-analysis

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Objective: This meta-analysis aims to evaluate the global prevalence of mental disorders among young people living with HIV.

Methods: A comprehensive search was conducted of the PubMed, Embase, and Cochrane Library databases for articles relevant to the study, published between January 2013 and June 2023. To identify sources of heterogeneity and compare prevalence estimates among various groups, subgroup analyses were conducted. Study heterogeneity was assessed using Cochran's Q and the I^2 tests. The robustness of the findings was ascertained through sensitivity analyses, while publication bias was evaluated with funnel plots and Egger's test.

Results: Sixty studies were included in this meta-analysis. It revealed that approximately one-quarter of YLWH experience depression, with a prevalence of 24.6% (95% CI: 21.1–28.2%). The prevalence of anxiety was found to be 17.0% (95% CI: 11.4–22.6%). Regarding suicidality, the prevalence of suicidal ideation and lifetime suicidal ideation in YLWH was 16.8% (95% CI: 11.3–22.4%) and 29.7% (95% CI: 23.7–35.7%), respectively. Additionally, the prevalence rates for suicidal attempts and lifetime suicidal attempts were 9.7% (95% CI: 4.0–15.4%) and 12.9% (95% CI: 2.8–23.1%), respectively. The prevalence of Post-Traumatic Stress Disorder and Attention Deficit Hyperactivity Disorder was identified as 10.5% (95% CI: 5.8–15.2%) and 5.0% (95% CI: 3.1–7.0%), respectively.

Conclusion: The findings indicate a heightened risk of mental disorders among YLWH, underscoring the necessity for targeted intervention strategies to mitigate their suffering and potentially diminish the adverse impacts.

Systematic Review Registration: PROSPERO, identifier CRD42023470050, https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42023470050.

KEYWORDS

young people, HIV, depression, anxiety, mental disorders, meta-analysis

Introduction

According to the World Health Organization (WHO), individuals aged 10–24 years constitute the young demographic (1). HIV persists as a major global health challenge, affecting approximately 39.0 million people worldwide in 2022, with a significant concentration in the WHO African Region (2). Alarmingly, the incidence of HIV is increasingly prevalent among young people, as evidenced by 480,000 new cases in this age group in 2022 alone (3).

Contemporary research indicates that individuals with HIV are more prone to mental health disorders than their non-infected counterparts (4, 5), a trend also observed in young people living with HIV (YLWH). Depression and anxiety are particularly prevalent mental health issues among YLWH. Research also indicates a significant prevalence of suicide, Post-Traumatic Stress Disorder (PTSD), and Attention-deficit hyperactivity disorder (ADHD) within this demographic (6, 7). The past decade has seen an escalation in research focusing on the mental health of YLWH. However, the global variation in reported mental disorder rates among YLWH underscores the need for more systematic research and thorough analysis. For example, the prevalence of anxiety among YLWH ranges from 2.2% in Indonesia to 56.7% in South Africa (8, 9), and for depression, it ranges from 3.3 to 52.6%, with both studies conducted in Kenya (10, 11). This variance can be attributed to factors such as diverse study population characteristics, disease stages, geographical locations, and the use of different standardized measurement tools. Additionally, research has linked mental health disorders with suboptimal adherence to antiretroviral therapy (ART), resulting in poor virologic control, drug resistance, and heightened HIV morbidity and mortality (12, 13). Therefore, comprehending the worldwide prevalence of mental disorders among young people living with HIV is of paramount importance and urgency.

Prior systematic reviews and meta-analyses have primarily focused on adolescents, with less emphasis on young adults. Our systematic review and meta-analysis extend the age range to encompass YLWH aged 10–24. This study is, to the best of our knowledge, the first to offer a comprehensive global synthesis of data regarding the prevalence of mental disorders among this demographic. The findings will offer critical insights into the prevalence of mental health conditions within this group, thus facilitating the creation of timely and impactful interventions.

Methods

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guideline was used to guide this review's design and reporting (14). Registration of the study was completed under the identifier CRD42023470050 with the International Prospective Register of Systematic Reviews (PROSPERO).

Search strategy and study eligibility

We conducted searches in PubMed, Embase, and the Cochrane Library from June 20, 2023, to June 30, 2023, for cross-sectional studies, longitudinal studies, and case–control studies on the prevalence of depression, anxiety, suicidality, PTSD, and ADHD YLWH aged 10 to 24 years, published between January 2013 and June 2023. The keywords and their combinations include HIV and all the synonyms; mental disorders, depression, anxiety, suicide, PTSD, ADHD and all their synonyms; adolescents and young people and all the synonyms (The full search strategy see Supplementary material 2 Table S1). The retrieved papers were included in this review if they met the following inclusion and exclusion criteria.

Inclusion criteria: (1) The study population was YLWH aged 10–24 years old; (2) Provide data on the prevalence of any or multiple mental disorders among the following: depression, anxiety, suicidality, PTSD, and ADHD. (3) Cross-sectional studies, longitudinal studies and case–control studies.

Exclusion criteria: (1) Case studies, reviews, comments, conference abstracts, case reports and letters; (2) Not English articles; (3) No data on the prevalence of any of the mental disorders including depression, anxiety, suicidality, PTSD, and ADHD were provided; (4) Age range of the study population is not specified; (5) The study population is not YLWH aged 10–24 years old.

Screening and data extraction

Following the search strategy, the retrieved articles were imported into Endnote X9, and duplicates were removed. Two researchers (SZ and WZ) independently screened the titles and abstracts for initial selection and then independently read the full texts for secondary screening. Studies to be included were determined based on the inclusion and exclusion criteria. Any discrepancies were adjudicated by a third researcher (FO).

Data extraction was conducted independently by two researchers (SZ and WZ), encompassing various study parameters: (1) Article's first author and publication year; (2) Country; (3) Study design; (4) ART status; (5) Sample size; (6) Male ratio; (7) Age range; (8) Mean or median age of participants; (9) Period of survey execution; (10) Instruments used for measurement; (11) Cut-off score; (12) Validation information for the measurement tools; (13) Prevalence of depression, anxiety, suicidality, PTSD, and ADHD. Specifically for suicide, separate assessments were made for suicidal ideation, lifetime suicidal ideation, suicidal attempts, and lifetime suicidal attempts. In the case of longitudinal studies, only baseline data were considered.

Quality assessment

For quality assessment, the Agency for Healthcare Research and Quality (AHRQ) cross-sectional study quality evaluation list, comprising 11 items, was utilized (15). Each item rated "yes" referring value "1" was summed giving a range of a possible total score between 0 and 11 on the checklist. Studies were classified based on quality into three categories: low (0–3 points), medium (4–7 points), and high (8–11 points). The evaluation was conducted by two researchers (SZ and WZ), using the AHRQ criteria. In cases of inconsistent evaluations, a third reviewer (FO) was consulted for reassessment.

Abbreviations: YLWH, Young people living with HIV; WHO, World Health Organization; PTSD, Post-traumatic stress disorder; ADHD, Attention-deficit hyperactivity disorder; ART, Antiretroviral therapy; AHRQ, Agency for Healthcare Research and Quality list; PHQ-9, Patient Health Questionnaire-9; BDI, Beck Depression Inventory; CDI, Child Depression Inventory; PHQ-A, Patient Health Questionnaire for Adolescents; CES-D, Center for Epidemiologic Studies Depression Scale; MINI-KID, Mini International Neuropsychiatric Interview for Children and Adolescents; GAD-7, Generalized Anxiety Disorder-7; RCMAS, Revised Children's Manifest Anxiety Scale; PC-PTSD, Primary care-PTSD screen; CPC, Child Post-Traumatic Stress Disorder Checklist; UCLA PTSD-RI, University of California Los Angeles PTSD Exposure questionnaire; SSA, Sub-Saharan Africa.

Data analysis

We employed the R4.2.3 software for calculating the aggregated prevalence of various mental disorders. The fixed effect model was applied in cases where the I^2 heterogeneity test indicated moderate or low heterogeneity ($I^2 < 50\%$); conversely, for substantial heterogeneity ($I^2 \geq 50\%$), the random effect model was utilized. The resultant composite findings were represented through forest plots. We conducted subgroup analyses to explore the sources of heterogeneity. To verify the reliability of our findings, we performed sensitivity analyses on mental disorders featured in over 10 studies to assess the impact of individual studies on the overall results. To address publication bias, we constructed funnel plots and applied Egger's test to mental disorder categories with at least 10 estimates (16).

Results

Search results

We conducted a search across PubMed (4,112 articles), Embase (6,808 articles), and the Cochrane Library (1,855 articles), totaling 12,775 articles. After excluding 2,845 duplicate articles, we reviewed the titles and abstracts of the remaining 9,930 articles, of which 235 articles underwent full-text eligibility screening. Among these, 175 articles were excluded, and ultimately, 60 articles were included in our meta-analysis. The selection process and reasons for exclusion were illustrated in Figure 1.

Study characteristics

The final 60 studies included in this systematic review and meta-analysis were published in years ranging from 2014 to 2023, with the highest number of studies published in 2020, with 10 studies. The included studies were from 26 countries, of which 15 were from African countries, 7 from Asian countries, 2 from European countries, 1 from North American countries, and 1 from South American countries. The number of studies conducted in Africa, Asia, North America, Europe, and South America was 44, 7, 6, 2, and 1, respectively. Among the 60 studies included, 54 adopted a cross-sectional design, with the remaining comprising 1 case–control and 5 longitudinal studies. Among the 44 studies reporting ART status, 32 had populations on ART, 11 had majorities on ART with over 85%

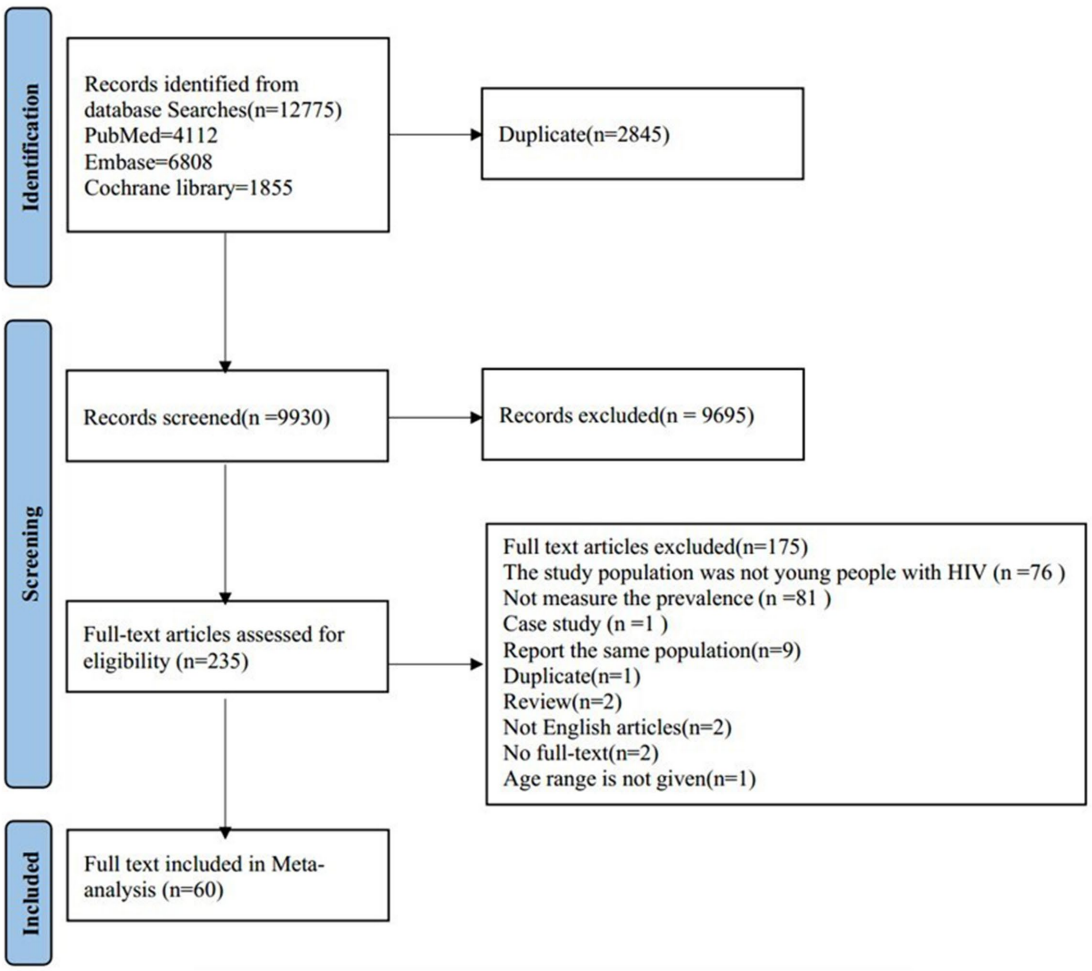

FIGURE 1
Flowchart of study selection.

uptake, and only 1 had a population not on ART. Of the 46 studies that reported the survey time, the period of investigation ranged from June 2005 to March 2022 (see Supplementary material 1 Table S1). Among the 60 observational studies, 13 were of high quality, 47 were rated as medium quality, and none were classified as low quality (see Supplementary material 1 Table S2).

Depression

In this meta-analysis, a total of 51 studies reported on the prevalence of depression in YLWH, as outlined in Table 1. These studies encompassed a collective sample size of 18,535 participants, revealing a pooled prevalence of depression at 24.6% (95% CI: 21.1–28.2%). Notably, there was substantial heterogeneity observed among the studies ($I^2 = 98.03\%$, $p < 0.001$). The majority of these studies were conducted in Africa, accounting for 39 of the total, while South America contributed the least, with only one study. The measurement tools for depression were diverse, with the Patient Health Questionnaire-9 (PHQ-9) being used in 18 studies, the Beck Depression Inventory (BDI) and Child Depression Inventory (CDI) in 6 studies, and Patient Health Questionnaire for Adolescents (PHQ-A), Center for Epidemiologic Studies Depression Scale (CES-D), and Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID) in 4 studies. Furthermore, 7 studies utilized different measurement tools, and 3 studies employed two tools concurrently.

The subgroup analysis of depression, as presented in Table 2, revealed variations in depression prevalence attributed to the measurement tools employed, yielding statistically significant differences among the groups ($p < 0.001$). Studies utilizing MINI-KID, PHQ-A, and BDI demonstrated reduced heterogeneity, particularly among those using PHQ-A ($I^2 = 0\%$, $p = 0.67$). Intriguingly, depression prevalence as determined by the PHQ-9 with a cut-off score of 5 was significantly higher (27.8, 95% CI: 18.0 to 37.5%) compared to a cut-off score of 10 (19.7, 95% CI: 11.3 to 28.1%). Similarly, the

TABLE 1 Prevalence estimates for depression among YLWH according to the measurement tool used.

Author, year	Country	Sample size (*n*)	Assessment tool used	Cut-off score	Information on local tool validation	Prevalence estimates
Sohn et al. (17)	Thailand, Vietnam, Malaysia	82	PHQ-9	≥9	NR	23.2%
Olashore et al. (18)	Botswana	622	MINI-KID	NR	NR	23.6%
Nguyen et al. (19)	Mozambique	213	PHQ-A	≥10	NR	11.7%
Ndongo et al. (20)	Cameroon	302	CDI	≥20	NR	26.5%
Mugo et al. (21)	Kenya	938	PHQ-9	≥5	Cronbach'α = 0.70	20.7%
Gamassa et al. (22)	Tanzania	170	PHQ-A	≥5	NR	15.9%
Brooks et al. (23)	Botswana	1,049	PHQ-9	≥5	Cronbach'α = 0.74	42.4%
Arnold et al. (24)	America	163	PHQ-9	≥10	NR	21.5%
Di Gennaro et al. (25)	Mozambique	1,096	PHQ-9	≥11	NR	7.1%
Chory et al. (10)	Kenya	30	PHQ-9	NR	NR	3.3%
Chantaratin et al. (26)	Thailand	100	PHQ-A	≥10	Sensitivity = 0.76 Specificity = 0.81	15.0%
Nyongesa et al. (27)	Kenya	406	PHQ-9	≥10	Cronbach'α = 0.83	28.8%
Mugo et al. (28)	Kenya	96	PHQ-9	≥5	Cronbach'α = 0.88	47.9%
Kohn et al. (29)	America	181	BDI	≥14	NR	39.8%
Girma et al. (30)	Ethiopia	325	PHQ-9	≥10	Cronbach'α = 0.89 Sensitivity = 0.88 Specificity = 0.88	30.2%
Getaye et al. (31)	Ethiopia	431	BDI	≥14	Cronbach'α = 0.85	26.2%
Filiatreau et al. (32)	South Africa	359	CES-D	≥16	Cronbach'α = 0.76	28.1%
Aurpibul et al. (33)	Thailand, Cambodia	193	CDI CES-D	>15 >22	NR NR	20.7%
Ashaba et al. (34)	Uganda	224	MINI-KID	NR	NR	16.5%
Adeyemo et al. (35)	Nigeria	201	MINI-KID	NR	NR	16.9%
Buckley et al. (36)	South Africa	81	PHQ-A	NR	NR	13.6%
Dyer et al. (37)	Kenya	479	PHQ-9	≥5	NR	10.0%
Ekat et al. (38)	Republic of Congo	135	PHQ-9	≥9	NR	38.5%

(Continued)

TABLE 1 (Continued)

Author, year	Country	Sample size (*n*)	Assessment tool used	Cut-off score	Information on local tool validation	Prevalence estimates
Haas et al. (8)	South Africa	1,088	PHQ-9	≥10	NR	4.4%
Cavazos-Rehg et al. (39)	Uganda	675	CDI	≥3	NR	52.3%
Yarhere et al. (40)	Nigeria	58	BDI	≥11	NR	44.8%
Agyemang et al. (41)	Ghana	139	PHQ-9	≥5	NR	26.6%
Kinyanda et al. (42)	Uganda	479	YI-4R CASI-5	NR NR	Cronbach'α = 0.88 Cronbach'α = 0.77	5.2%
Kemigisha et al. (43)	Uganda	336	CES-D	≥15	Cronbach'α = 0.85	45.8%
Abebe et al. (44)	Ethiopia	507	BDI	≥21	NR	35.5%
Casale et al. (45)	South Africa	1,053	CDI	NR	Cronbach'α = 0.64	46.0%
Zhou et al. (46)	China	145	CDI	≥19	Cronbach'α = 0.82	32.4%
Wonde et al. (47)	Ethiopia	413	PHQ-9	≥10	NR	31.7%
Coetzee et al. (48)	South Africa	134	RCADS	≥65	Cronbach'α = 0.86	9.7%
Gaitho et al. (11)	Kenya	270	PHQ-9	≥1	NR	52.6%
Ramos et al. (49)	Tanzania	280	PHQ-9	≥10	NR	20.4%
Okawa et al. (50)	Zambia	190	CES-D	≥10	Cronbach'α = 0.74	25.3%
West et al. (51)	South Africa	112	CDI	≥7	NR	10.7%
Earnshaw et al. (52)	South Africa	250	BDI	≥20	Cronbach'α = 0.90	33.8%
Prevost et al. (53)	England	283	HADS	≥8	NR	16.0%
Chenneville et al. (54)	America	131	PHQ-9 PHQ-A	≥10 ≥10	NR NR	21.4%
Woollett et al. (7)	South Africa	343	CDI	≥10	Cronbach'α >0.70	14.3%
Bankole et al. (55)	Nigeria	31	MINI-KID	NR	NR	41.9%
Dow et al. (56)	Tanzania	182	PHQ-9	≥10	NR	12.1%
Fawzi et al. (57)	Rwanda	193	CES-D	≥30	NR	26.4%
Funck-Brentano et al. (58)	France	54	Psychological Interview	NA	NA	16.7%
Côté et al. (59)	Brazil	268	BDI	≥14	Cronbach'α = 0.89	23.9%
Vreeman et al. (60)	Kenya	285	PHQ-9	≥5	NR	18.9%
Lewis et al. (61)	America	166	BDI	≥10	Cronbach'α = 0.87	34.3%
Brown et al. (62)	America	2032	BSI	≥63	Cronbach'α = 0.98	20.6%
Kim et al. (63)	Malawi	562	CDRS-R	≥55	NR	18.9%

NR, Not Reported; NA, Not Applicable; MINI-KID, Mini International Neuropsychiatric Interview for Children and Adolescents; CDI, Children Depression Inventory; BDI, Beck Depression Inventory; PHQ-9, Patient Health Questionnaire-9-item depression instrument; PHQ-A, Patient Health Questionnaire for Adolescents; CES-D, Center for Epidemiologic Studies Depression Scale; YI-4R, Youth Inventory-4R; CASI-5, Child and Adolescent Symptom Inventory-5; RCADS, Revised Children's Anxiety and Depression Scale; BSI, Brief Symptom Inventory; CDRS-R, Children's Depression Rating Scale-Revised; HADS, Hospital Anxiety and Depression Scale.

depression prevalence assessed by the PHQ-9 (cut-off score of 5) closely mirrored that assessed by the BDI (cut-off score of 14).

The prevalence of depression also demonstrated significant geographic variation. The highest pooled prevalence was observed in North America (27.2, 95% CI: 19.5–35.0%), and the lowest in Europe (16.1, 95% CI: 12.2–20.0%). Notably, heterogeneity was considerably reduced in studies from Asia, North America, and Europe, with respective I^2 values of 73.36, 89.32, and 0%. Gender and age-based Subgroup analyses showed that the prevalence of depression in females (33.7, 95% CI: 26.5–40.8%) was higher than in males (29.2, 95% CI: 20.9–37.5%), but the difference did not reach statistical significance ($p = 0.42$). Additionally, higher prevalence rates were observed in older youth, with the 20–24 age group showing a prevalence of 36.2% (95% CI: 18.3–54.1%) and the 15–19 age group (31.9, 95% CI: 17.9–45.8%), compared to the 10–14 age group (24.7, 95% CI: 16.0–33.5%); However, these differences did not achieve statistical significance either ($p = 0.44$).

Anxiety

The meta-analytic synthesis of anxiety prevalence, conducted across 19 studies as delineated in Table 3, revealed a summary prevalence of 17.0% (95% CI: 11.4–22.6%) from a collective sample of

TABLE 2 Overall and subgroup analysis of prevalence of mental disorders in YLWH.

Subgroups	Studies, *n*	Sample size, *n*	Prevalence (%)	95%CI (%)	I^2 (%)	*p*-value	Heterogeneity between groups (*p*-value)
Depression							
Overall	51	18,535	24.6	21.1 ~ 28.2	97.99	<0.001	
Continent							0.010
Africa	39	14,737	25.0	20.6 ~ 29.4	98.41	<0.001	
Asia	4	520	22.7	15.5 ~ 29.8	73.36	0.010	
North America	5	2,673	27.2	19.5 ~ 35.0	89.32	<0.001	
Europe	2	337	16.1	12.2 ~ 20.0	0.00	0.900	
South America	1	268	23.9	18.8 ~ 29.0	–	–	
Measurement tools							<0.001
PHQ-9	18	7,456	24.2	17.6 ~ 30.9	98.49	<0.001	
PHQ-A	4	564	13.6	10.8 ~ 16.4	0.00	0.670	
CES-D	4	1,078	31.5	22.0 ~ 41.0	91.69	<0.001	
MINI-KID	4	1,078	21.7	14.5 ~ 28.9	79.19	<0.001	
BDI	6	1861	33.1	28.1 ~ 38.0	73.18	0.002	
CDI	6	2,630	30.4	17.0 ~ 43.8	98.50	<0.001	
CDI&CES-D	1	193	20.7	15.0 ~ 26.4	–	–	
YI-4R&CASI-5	1	479	5.2	3.2 ~ 7.2	–	–	
RCADS	1	134	9.7	4.7 ~ 14.7	–	–	
HADS	1	283	16.0	11.7 ~ 20.3	–	–	
PHQ-9&PHQ-A	1	131	21.4	14.4 ~ 28.4	–	–	
BSI	1	2032	20.6	18.8 ~ 22.4	–	–	
CDRS-R	1	562	18.9	15.7 ~ 22.1	–	–	

(Continued)

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TABLE 2 (Continued)

Subgroups	Studies, *n*	Sample size, *n*	Prevalence (%)	95%CI (%)	I^2 (%)	*p*-value	Heterogeneity between groups (*p*-value)
Measurement and cut-off score							<0.001
PHQ-9 ≥ 5	7	3,311	27.8	18.0 ~ 37.5	97.92	<0.001	
PHQ-9 ≥ 9	2	217	31.0	16.0 ~ 46.0	83.23	0.010	
PHQ-9 ≥ 10	6	2,532	19.7	11.3 ~ 28.1	98.15	<0.001	
PHQ-9 ≥ 1	1	270	52.6	46.6 ~ 58.6	–	–	
PHQ-9 ≥ 11	1	1,096	7.1	5.6 ~ 8.6	–	–	
PHQ-A ≥ 5	1	170	15.9	10.4 ~ 21.4	–	–	
PHQ-A ≥ 10	2	313	12.6	8.9 ~ 16.3	0.00	0.620	
BDI ≥ 10	1	166	34.3	27.1 ~ 41.5	–	–	
BDI ≥ 11	1	58	44.8	32.0 ~ 57.6	–	–	
BDI ≥ 14	3	880	29.6	20.3 ~ 39.0	85.39	0.001	
BDI ≥ 20	1	250	33.8	27.9 ~ 39.7	–	–	
BDI ≥ 21	1	507	35.5	31.3 ~ 39.7	–	–	
CDI ≥ 3	1	675	52.3	48.5 ~ 56.1	–	–	
CDI ≥ 7	1	112	10.7	5.0 ~ 16.4	–	–	
CDI ≥ 10	1	343	14.3	10.6 ~ 18.0	–	–	
CDI ≥ 19	1	145	32.4	24.8 ~ 40.0	–	–	
CDI ≥ 20	1	302	26.5	21.5 ~ 31.5	–	–	
CES-D ≥ 10	1	190	25.3	19.1 ~ 31.5	–	–	
CES-D ≥ 15	1	336	45.8	40.5 ~ 51.1	–	–	
CES-D ≥ 16	1	359	28.1	23.5 ~ 32.7	–	–	
CES-D ≥ 30	1	193	26.4	20.2 ~ 32.6	–	–	
RCADS≥65	1	134	9.7	4.7 ~ 14.7	–	–	
HADS≥8	1	283	16.0	11.7 ~ 20.3	–	–	
BSI ≥ 63	1	2032	20.6	18.8 ~ 22.4	–	–	
CDRS-R ≥ 55	1	562	18.9	15.7 ~ 22.1	–	–	
Sex							0.420
Male	13	3,181	29.2	20.9 ~ 37.5	95.82	<0.001	
Female	13	2,712	33.7	26.5 ~ 40.8	94.78	<0.001	

(Continued)

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TABLE 2 (Continued)

Subgroups	Studies, *n*	Sample size, *n*	Prevalence (%)	95%CI (%)	I^2 (%)	*p*-value	Heterogeneity between groups (*p*-value)
Age group							0.440
10 ~ 14	7	1,074	24.7	16.0 ~ 33.5	94.27	<0.001	
15 ~ 19	9	1,647	31.9	17.9 ~ 45.8	97.79	<0.001	
20 ~ 24	3	520	36.2	18.3 ~ 54.1	94.56	<0.001	
Anxiety							
Overall	19	8,585	17.0	11.4 ~ 22.6	97.95	<0.001	
Continent							0.680
Africa	13	5,955	14.0	8.6 ~ 19.4	98.22	<0.001	
Asia	2	130	32.6	0.0 ~ 78.3	95.83	<0.001	
Europe	2	337	24.8	0.0 ~ 54.9	97.44	<0.001	
North America	2	2,163	18.8	7.4 ~ 30.2	89.07	0.002	
Measurement tools							<0.001
GAD-7	6	3,983	16.7	7.9 ~ 25.4	99.00	<0.001	
RCMAS	2	455	15.4	0.0 ~ 33.2	96.78	<0.001	
MASC	1	302	29.1	24.0 ~ 34.2	–	–	
Hopkins questionnaires	1	30	3.3	0.0 ~ 9.7	–	–	
SCAS	1	30	56.7	39.0 ~ 74.4	–	–	
SCARED	1	100	10.0	4.1 ~ 15.9	–	–	
PHQ-A	1	81	3.7	0.0 ~ 7.8	–	–	
YI-4R&CASI-5	1	479	14.7	11.5 ~ 17.9	–	–	
RCADS	1	134	6.7	2.5 ~ 10.9	–	–	
HADS	1	283	40.0	34.3 ~ 45.7	–	–	
BSI	1	2032	13.5	12.0 ~ 15.0	–	–	
MINI-KID	1	622	18.0	15.0 ~ 21.0	–	–	
Suicidal ideation							
Overall	16	5,476	16.8	11.3 ~ 22.4	95.04	<0.001	

(Continued)

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TABLE 2 (Continued)

Subgroups	Studies, *n*	Sample size, *n*	Prevalence (%)	95%CI (%)	I^2 (%)	*p*-value	Heterogeneity between groups (*p*-value)
Measurement tools							<0.001
PHQ-9	3	397	12.7	2.7 ~ 22.9	86.00	<0.001	
CDI	2	413	29.3	14.8 ~ 43.8	89.54	0.002	
PHQ-A	2	251	35.8	25.3 ~ 46.3	63.39	0.010	
MINI-KID	3	1,597	15.3	6.3 ~ 24.3	95.51	<0.001	
CES-D	1	336	7.7	4.8 ~ 10.6	–	–	
CIDI	1	413	5.7	3.5 ~ 7.9	–	–	
YSR	1	218	21.1	15.7 ~ 26.5	–	–	
CDRS-R	1	562	7.1	5.0 ~ 9.2	–	–	
Sample size							0.260
<300	9	1,371	19.8	12.7 ~ 26.8	93.22	<0.001	
≥300	7	4,105	13.3	4.7 ~ 21.9	96.36	<0.001	
Suicidal attempts							
Overall	9	3,603	9.7	4.0 ~ 15.4	96.09	<0.001	
Sample size							0.210
<300	4	780	14.1	3.9 ~ 24.3	97.10	<0.001	
≥300	5	2,823	6.5	0.6 ~ 12.4	96.04	<0.001	
Measurement tools							<0.001
MINI-KID	5	2,611	6.0	0.0 ~ 12.3	96.57	<0.001	
CIDI	1	413	3.4	1.7 ~ 5.1	–	–	
YSR	1	218	21.1	15.7 ~ 26.5	–	–	
Lifetime suicidal ideation							
Overall	2	614	29.7	23.7 ~ 35.7	58.81	0.120	
Lifetime suicidal attempts							
Overall	5	1,344	12.9	2.8 ~ 23.1	96.90	<0.001	
Measurement tools							<0.001
MINI-KID	2	593	2.2	0.9 ~ 3.4	15.42	0.280	
PHQ-A	1	170	14.7	9.4 ~ 20.0	–	–	
CIDI	1	413	16.9	13.3 ~ 20.5	–	–	

(Continued)

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TABLE 2 (Continued)

Subgroups	Studies, *n*	Sample size, *n*	Prevalence (%)	95%CI (%)	I^2 (%)	*p*-value	Heterogeneity between groups (*p*-value)
Sample size							
<300	3	539	15.3	0.0 ~ 31.6	97.48	<0.001	
≥300	2	805	9.8	0.0 ~ 23.6	97.94	<0.001	
PTSD							
Overall	8	3,313	10.5	5.8 ~ 15.2	94.77	<0.001	
Measurement tools							0.890
PC-PTSD	3	2,315	11.8	3.0 ~ 20.6	97.99	<0.001	
CPC	3	536	9.1	0.0 ~ 20.5	87.55	<0.001	
UCLA PTSD-RI	2	462	12.0	9.0 ~ 14.9	0.00	0.360	
Sample size							0.300
<300	5	786	12.7	6.2 ~ 19.1	89.29	<0.001	
≥300	3	2,527	7.6	0.7 ~ 14.6	97.71	<0.001	
ADHD							
Overall	4	957	5.0	3.1 ~ 7.0	42.34	0.160	

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TABLE 3 Prevalence estimates for anxiety among YLWH according to the measurement tool used.

Author, year	Country	Sample size (*n*)	Assessment tool used	Cut-off score	Information on local tool validation	Prevalence estimates
Olashore et al. (64)	Botswana	622	MINI-KID	NR	NR	18.0%
Nguyen et al. (19)	Mozambique	213	GAD-7	≥10	NR	12.2%
Ndongo et al. (20)	Cameroon	302	MASC	NR	NR	29.1%
Brooks et al. (23)	Botswana	1,049	GAD-7	≥5	Cronbach'α = 0.81	32.1%
Chory et al. (10)	Kenya	30	Hopkins questionnaires	NR	NR	3.3%
Satriawibawa et al. (9)	Indonesia	30	SCAS	≥60	NR	56.7%
Di Gennaro et al. (25)	Mozambique	1,096	GAD-7	≥10	NR	10.3%
Chantaratin et al. (26)	Thailand	100	SCARED	≥25	Sensitivity = 0.79 Specificity = 0.82	10.0%
Nyongesa et al. (27)	Kenya	406	GAD-7	≥10	Cronbach'α = 0.86	19.0%
Buckley et al. (36)	South Africa	81	PHQ-A	NR	NR	3.7%
Haas et al. (8)	South Africa	1,088	GAD-7	≥10	NR	2.2%
Kinyanda et al. (42)	Uganda	479	YI-4R CASI-5	NR	Cronbach'α = 0.88 Cronbach'α = 0.77	14.7%
Coetzee et al. (48)	South Africa	134	RCADS	≥65	Cronbach'α = 0.89	6.7%
West et al. (51)	South Africa	112	RCMAS	≥10	NR	6.3%
Prevost et al. (53)	England	283	HADS	≥8	NR	40.0%
Chenneville et al. (54)	America	131	GAD-7	≥10	NR	25.2%
Woollett et al. (7)	South Africa	343	RCMAS	NR	NR	24.5%
Funck-Brentano et al. (58)	France	54	NR	NR	NR	9.3%
Brown et al. (62)	America	2032	BSI	≥63	Cronbach'α = 0.98	13.5%

NR, Not Reported; MINI-KID, Mini International Neuropsychiatric Interview for Children and Adolescents; GAD-7, Generalized Anxiety Scale-7; MASC, Multidimensional Anxiety Scale for Children; SCAS, Spence children's anxiety scale; SCARED, Screen for Child Anxiety Related Disorder; PHQ-A, Patient Health Questionnaire for Adolescents; YI-4R, Youth Inventory-4R; CASI-5, Child and Adolescent Symptom Inventory-5; RCADS, Revised Children's Anxiety and Depression Scale; RCMAS, Revised Children's Manifest Anxiety Scale; HADS, Hospital Anxiety and Depression Scale; BSI, Brief Symptom Inventor.

8,585 participants. This analysis uncovered considerable heterogeneity across studies (I^2 = 97.95%, p < 0.001). Samples were sourced from a variety of geographic regions: Asia (n = 2), Africa (n = 13), North America (n = 2), and Europe (n = 2). Six studies predominantly utilized the Generalized Anxiety Disorder-7 (GAD-7) scale with a threshold of 10, whereas the Revised Children's Manifest Anxiety Scale (RCMAS) was used in 2 studies. Notably, 1 study did not specify the measurement tool employed, another utilized two different tools concurrently, and the remaining 10 studies incorporated various other instruments.

In the stratified meta-analyses by continent and assessment instruments (Table 2), we explored the factors contributing to the observed heterogeneity and detailed the anxiety prevalence across continents. The pooled prevalence of anxiety in YLWH varied considerably, ranging from 14.0% in Africa (95% CI: 8.6–19.4%) to 32.6% in Asia (95% CI: 0.0–78.3%); however, these intercontinental differences did not reach statistical significance (p = 0.68). Subgroup analyses further revealed variations in anxiety prevalence depending on the measurement tools used, with significant differences detected (p < 0.001). The overall pooled prevalence and the prevalence determined using the GAD-7 (16.7, 95% CI: 7.9–25.4%) exhibited similarity.

Suicidality

A total of 5,476 participants from 16 studies assessed suicidal ideation, while 614 participants from 2 studies evaluated lifetime suicidal ideation, as noted in Table 4. Regarding suicide attempts, 9 studies (totaling 3,603 participants) reported on suicide attempt prevalence, and 5 studies (with 1,344 participants) on lifetime suicide attempt prevalence (Table 4). As shown in Table 2, random effect prevalence estimates varied from 9.7% (95% CI: 4.0–15.4%) for lifetime attempts to 29.7% (95% CI: 23.7–35.7%) for suicidal ideation prevalence. Heterogeneity measures were notably high across all outcomes, with I^2 ranging from 58.81 to 96.90%.

Subgroup analysis revealed significant differences in suicidal ideation prevalence when measured with the PHQ-A (35.8, 95%CI: 25.3–46.3%) and CDI (29.3, 95%CI: 14.8–43.8%), compared to the MINI-KID (15.3, 95%CI: 6.3–24.3%) and PHQ-9 (12.7, 95%CI: 2.7–22.8%). Additionally, marked differences were noted in the prevalence of suicidal and lifetime suicide attempts across measurement tools (p < 0.001). Analysis stratified by sample size revealed that studies with smaller sample sizes (<300) indicated higher rates of suicidal ideation, attempts, and lifetime attempts compared to those with larger sample sizes (≥300).

TABLE 4 Prevalence estimates for suicidality among YLWH according to the measurement tool used.

Author, year	Country	Sample size (*n*)	Assessment tool used	Cut-off score	Information on local tool validation	Prevalence estimates
Sohn et al. (17)	Thailand, Vietnam, Malaysia	82	PHQ-9	NR	NR	SI 17.1% LTSA 14.7%
Ndongo et al. (20)	Cameroon	302	CDI	NR	NR	SI 36.4%
Arnold et al. (24)	America	168	NR	NR	NR	SA 23.5% LTSA 30.4%
Gamassa et al. (22)	Tanzania	170	PHQ-A	NR	NR	SI 31.2%
Gennaro et al. (25)	Mozambique	1,096	Self-report	NA	NA	SI 5.9%
Olashore et al. (64)	Botswana	622	MINI-KID	NR	NR	SA 18.8%
Namuli et al. (65)	Uganda	111	CDI	The score of item 9 = 1 or 2	NR	SI 21.6%
Adeyemo et al. (35)	Nigeria	201	MINI-KID	NR	NR	SI 14.9% LTSI 33.3% SA 1.0% LTSA 1.5%
Buckley et al. (36)	South Africa	81	PHQ-A	NR	NR	SI 42.0%
Rukundo et al. (66)	Uganda	392	MINI-KID	NR	NR	SA 1.8% LTSA 2.8%
Kemigisha et al. (43)	Uganda	336	CES-D	NR	Cronbach'α = 0.85	SI 7.7%
Casale et al. (45)	South Africa	1,053	MINI-KID	NR	Cronbach'α = 0.88	SI 8.0% SA 4.0%
Wonde et al. (47)	Ethiopia	413	CIDI	NR	NR	SI 5.7% LTSI 27.1% SA 3.4% LTSA 16.9%
López et al. (67)	America	45	PHQ-9	NR	NR	SI 20.0%
Gaitho et al. (11)	Kenya	270	PHQ-9	NR	NR	SI 4.4%
Woollett et al. (7)	South Africa	343	MINI-KID	NR	Cronbach'α = 0.75	SI 24.0% SA 5.0%
Fawzi et al. (57)	Rwanda	193	Self-report	NA	NA	SI 10.9% SA 11.9%
Ng et al. (68)	Rwanda	218	YSR	NR	Cronbach'α = 0.89	SI 21.1% SA 21.1%
Kim et al. (63)	Malawi	562	CDRS-R	The score of question 13 > 2	NR	SI 7.1%

NR, Not Reported; NA, Not Applicable; SI, Suicidal ideation; LTSI, Lifetime suicidal ideation; SA, Suicidal attempts, LTSA, Lifetime suicidal attempts; PHQ-9, Patient Health Questionnaire-9-item depression instrument; CES-D, Center for Epidemiologic Studies Depression Scale; PHQ-A, Patient Health Questionnaire for Adolescents; CIDI, World Health Organization Composite International Diagnostic Interview; CDI, Children Depression Inventory; CDRS-R, Children's Depression Rating Scale-Revised; YSR, Youth Self-Report Internalizing Subscale; MINI-KID, Mini International Neuropsychiatric Interview for Children and Adolescents.

PTSD and ADHD

Eight studies reported on the prevalence of PTSD, as indicated in Table 5, encompassing a combined sample size of 3,313 participants. There was a notable variation in the reported prevalence of PTSD, with substantial heterogeneity observed ($I^2 = 94.77\%$, $p < 0.001$). Consequently, a random effects model was employed to aggregate the prevalence rates, yielding an overall prevalence of 10.5% (95% CI: 5.8–15.2%). Across the included studies, a total of three different measurement tools were utilized, with three studies employing both the Primary care-PTSD screen (PC-PTSD) and Child Post-Traumatic Stress Disorder Checklist (CPC), while the remaining two studies utilized the University of California Los Angeles PTSD Exposure questionnaire (UCLA PTSD-RI) for assessment.

Table 6 displays the ADHD prevalence rates from all studies included. Heterogeneity testing yielded low to moderate levels ($I^2 = 42.34\%$, $p = 0.16$), necessitating the use of a fixed effects model for the analysis. ADHD prevalence in YLWH was determined to be 5.0% (95% CI: 3.1–7.0%).

Additionally, subgroup analysis presented in Table 2, which focused on the measurement tools for PTSD, showed that the prevalence rates assessed by different tools were comparable, with no statistically significant variations found across groups ($p = 0.22$). It was noted that studies with smaller sample sizes (<300) reported higher prevalence rates compared to those with larger sample sizes (≥300), though these differences were not statistically significant ($p = 0.30$).

Sensitivity analysis and publication bias

The sensitivity analysis revealed that no individual study significantly influenced the aggregated prevalence rates of depression, anxiety, or suicidal ideation, indicating a stable overall outcome (see Supplementary material 2 Figures S3, S4, S6). Funnel plots for depression, anxiety and suicidal ideation showed significant asymmetry (see Supplementary material 2 Figures S12–S14). Egger's test indicated a significant risk of publication bias in the pooled prevalence rates of depression, anxiety, and suicidal ideation ($p < 0.05$).

TABLE 5 Prevalence estimates for PTSD among YLWH according to the measurement tool used.

Author, year	Country	Sample size (*n*)	Assessment tool used	Cut-off score	Information on local tool validation	Prevalence estimates
Gennaro et al. (25)	Mozambique	1,096	PC-PTSD	≥3	NR	14.70%
Buckley et al. (36)	South Africa	81	CPC	≥20	NR	22.20%
Haas et al. (8)	South Africa	1,088	PC-PTSD	≥3	NR	3.50%
Ramos et al. (49)	Tanzania	280	UCLA PTSD-RI	≥18	NR	13.20%
West et al. (51)	South Africa	112	CPC	≥3	NR	2.70%
Chenneville et al. (54)	America	131	PC-PTSD	≥3	NR	18.30%
Woollett et al. (7)	South Africa	343	CPC	NR	Cronbach'α = 0.89	4.70%
Dow et al. (56)	Tanzania	182	UCLA PTSD-RI	≥18	Cronbach'α ≥ 0.90	10.40%

NR, Not Reported; PTSD, Post-traumatic stress disorder; CPC, Child Post-Traumatic Stress Disorder Checklist; PC-PTSD, Primary care-PTSD screen; UCLA PTSD-RI, University of California Los Angeles PTSD Exposure questionnaire.

TABLE 6 Prevalence estimates for ADHD among YLWH according to the measurement tool used.

Author, year	Country	Sample size (*n*)	Assessment tool used	Cut-off score	Information on local tool validation	Prevalence estimates
Zhou et al. (69)	China	479	SDQ	NR	Cronbach'α = 0.72	6.2%
Kinyanda et al. (42)	Uganda	325	YI-4R CASI-5	NR	Cronbach'α = 0.88 Cronbach'α = 0.77	6.4%
Gentz et al. (70)	Namibia	99	SDQ	NR	NR	4.0%
Funck-Brentano et al. (58)	France	54	Psychological interview	NA	NA	1.9%

NR, Not reported; NA, Not Applicable; YI-4R, Youth Inventory-4R; CASI-5, Child and Adolescent Symptom Inventory-5; SDQ, The Strengths and Difficulties Questionnaire.

Discussion

This systematic review and meta-analysis included a total of 60 studies from 26 different countries, focusing on the mental disorders among YLWH. In general, the prevalence of depression, anxiety, suicidal ideation, lifetime suicidal ideation, suicidal attempts, lifetime suicidal attempts, PTSD, and ADHD was assessed. To our knowledge, this is the first systematic evaluation of mental disorders in YLWH globally.

The meta-analysis revealed that depression and anxiety are the predominant mental disorders among YLWH, with the pooled prevalence rates being 24.6% (95% CI: 21.1–28.2%) for depression and 17.0% (95% CI: 11.4–22.6%) for anxiety, respectively (71, 72). Compared to general young people, depression and anxiety are 2.34 and 2.62 times more prevalent in YLWH in the current study, respectively. Considering the large number of YLWH worldwide, depression and anxiety issues should be the major health priorities for this population. The greater prevalence of depression in YLWH could be attributed to several factors. The first is the release of monoamines and increased levels of cytokines that promote inflammation (73). Additionally, depression's start is significantly linked to psychosocial stigma-related factors (74). Similarly, there is proof that stigma connected to HIV and anxiety are strongly correlated (75). Consistent with the reported rates of depression in the general young population, our meta-analysis found that depression is more prevalent among female YLWH than their male counterparts, and higher among older youth compared to their younger peers (76, 77). The gender disparity in depression prevalence may stem from differing societal expectations and moral standards for men and women, alongside varying degrees of social discrimination and psychological stress. Our study found that depression prevalence varied from 16.1 to 27.2%, while anxiety prevalence ranged from 14.0 to 32.6% across different continents. Instead of being only due to changes in geography, these disparities could also be ascribed to variations in social level, religious affiliation, and cultural diversity. The included studies use a variety of measurement tools to measure depression and anxiety, and most of these measurement tools had unclear sensitivity and accuracy. We therefore conducted subgroup analyses of depression and anxiety based on measurement tools. Surprisingly, the prevalence of depression and anxiety measured by different measurement tools and even the prevalence of depression measured using the same measurement tools but with different cut-off scores varied considerably. So it is important to use validated assessment methods carefully because doing otherwise can lead to inaccurate or misleading results (78).

While antiretroviral therapy offers considerable benefits, the issue of suicidality among HIV/AIDS patients continues to pose

a significant public health challenge, especially in developing countries (79, 80). The meta-analysis showed that 16.8% of young people living with HIV experienced suicidal ideation, and 9.7% attempted suicide, rates significantly exceeding those in the general population (81). However, a recent review on suicidal ideation in Chinese adults with HIV found the incidence to be 30.6% (82). This may be because in many countries, adults and middle-aged individuals, who bear significant economic and family responsibilities, face high social pressures and are at greater risk of suicide. Our analysis of the available data revealed that 29.7% of young people living with HIV (YLWH) reported experiencing lifetime suicidal ideation, while 12.9% reported lifetime suicide attempts. Previous research indicates that both physiological factors (HIV infection status, low CD4 cell counts, opportunistic infections, adverse reactions to antiretroviral therapy) and psychosocial factors (depression, high stress, low social support, violence, discrimination exposure) significantly contribute to suicidality risk in individuals with HIV (83–85). Among YLWH, studies have shown a higher prevalence of opportunistic infections and a greater risk of stigma and discrimination (74, 86). Therefore, suicidality among YLWH should require urgent attention in terms of prevention and treatment.

This meta-analysis offers, to the best of our knowledge, the first global assessment of PTSD and ADHD among YLWH. Data from 8 studies were combined to evaluate the prevalence of PTSD in YLWH in the current meta-analysis. The prevalence of PTSD from the 2 studies was merged in a meta-analysis examining psychiatric disorders in HIV-infected individuals less than 19 years of age in sub-Saharan Africa (SSA), and the resuls was 3.0% (87), which is substantially lower than what we measured (10.5%). However, a different meta-analysis with adult HIV-infected patients as the research group found that the prevalence of PTSD was 2.40 times greater than ours (88). There is one rationale why this might be the case. According to a study conducted on HIV-infected patients, PTSD is linked to HIV infection duration (89). The fact that young people have had an HIV diagnosis for a shorter amount of time may thus account for this difference. Despite this, YLWH still has a much higher prevalence of PTSD than the general population (3.9%) (90) and other vulnerable groups, such as cancer patients (5.1%) (91). Our meta-analysis revealed that 5.0% of YLWH had ADHD, which was less than what was previously reported in kids and adolescents with HIV in the prior review (92). This may be a result of the beneficial effects of early ART on the developing brain (93), in comparison to the pre-ART era, the introduction of ART both prenatally and postnatally may have considerably reduced the rate of ADHD among YLWH.

Identifying several limitations in this meta-analysis is crucial. Firstly, because there were variations in the research populations, study designs, measurement tools, and their cutoff values, there was a considerable degree of heterogeneity among the included studies. Secondly, the majority of the prevalence of mental disorders found in this study was derived from research conducted in African nations, which may limit the applicability of our findings elsewhere. And more excellent research from other continents is anticipated to be available in the future, which will allow us to update our findings even further.

Conclusion

This systematic review and meta-analysis found a significantly higher prevalence of mental disorders among YLWH, highlighting the benefits of early screening and intervention, particularly for females. More high-quality longitudinal studies are required to explore the reasons behind the increased prevalence of mental disorders in this group. Additionally, research into improved screening, prevention, and intervention methods for these issues is necessary.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

SZ: Writing – original draft, Writing – review & editing. FO: Writing – review & editing. WZ: Writing – review & editing. HY: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2024.1392872/full#supplementary-material

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Promoting equity in adolescent health in Latin America: designing a comprehensive Sex education program using Intervention Mapping. A mixed methods study

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Introduction: Implementing sex education programs during adolescence is crucial for addressing the risks associated with sexuality. However, some of these interventions lack proper incorporation of a gender perspective and maintain a heteronormative and biologically-focused approach, potentially resulting in inequitable outcomes for adolescents. In response, comprehensive sex education is most effective due to its multidimensional view of sexuality. However, integrating a comprehensive perspective on sexuality and a gender lens that contributes to adolescent health equity presents challenges, especially in low and middle-income countries. This study aimed to develop a comprehensive and gender-transformative sex education program for adolescents in a middle-income country of Latin America, utilizing the Intervention Mapping Approach.

Methods: This exploratory sequential mixed-method study comprised two phases. In the first phase, a literature review, nine focus groups with high school students, and 14 interviews with school professionals were conducted to inform program design. Subsequently, the program underwent validation through expert judgment. In the second phase—as part of program development—a preliminary evaluation was conducted by implementing the program in two high schools with 30 students from public high schools, who were administered a pre-post *ad hoc* survey.

Results: A comprehensive and gender-transformative sex education program was designed based on literature review findings and input from students and school workers. The *ad hoc* survey revealed a statistically significant increase in protective skills in sexuality ($W = 59$, $p = .01$) among all participants.

Discussion: Designing a sex education intervention through Intervention Mapping allowed for the integration of evidence and the needs of the target population. The results of the preliminary evaluation suggest the potential of the developed program to enhance protective skills in sexuality and promote health equity through gender-equitable outcomes in adolescent sex education.

KEYWORDS

sex education, adolescents, health equity, gender equity in health, Intervention Mapping, framework for gender-transformative health promotion, gender equity

1 Introduction

Adolescence marks a period where sexuality is a normative aspect of development (1). However, adolescents encounter specific challenges, such as physical, psychological, and sexual changes, along with the exploration of sexual orientation and gender identity. Insufficient access to information and difficulties in assessing risk further compound their vulnerability in sexual experiences (2–5). These challenges can manifest in risky sexual behavior (6), predisposing adolescents to sexually transmitted infections (STIs), unintended pregnancies, and interpersonal or legal conflicts (7). Moreover, adverse sexual experiences are associated with detrimental mental health outcomes including depression, negative perceptions of sexual relationships, anxiety, substance use, post-traumatic stress disorder, and suicidal ideation/suicidality (8–12). Notably, these complexities are exacerbated in contexts where adolescents encounter additional adversities such as sexual violence, limited educational opportunities, elevated prevalence of STIs, economic disparities, gender-based discrimination, heightened vulnerability stemming from ethnic backgrounds, and barriers to accessing sexuality related information, factors that are particularly pronounced in low and middle-income countries (13–18).

Sexuality represents a complex facet of human identity, influenced by a myriad of factors such as biology, psychology, culture, religion, and spirituality (19). Gender identity, and gender roles, norms, stereotypes, attributes, and behaviors deemed suitable by society based on an individual's gender, intricately shapes self-perception, interactions, and power dynamics. In this way, gender closely intertwines with sexuality as social norms, partly constructed by gender roles, influence the experience of sexuality (20–22). During adolescence, gender disparities become evident in the impact of sexual experiences. Early initiation of sexual activity may lead to a decline in well-being, particularly impacting females (23, 24). Non-binary adolescents may encounter internalizing or externalizing symptoms stemming from inadequate support, social exclusion, and bullying (25–27). Additionally, partner violence has been linked with mental health challenges in females (28, 29), highlighting a significant correlation. Furthermore, sexual health services predominantly cater to girls, often neglecting consideration for boys (30, 31).

The preceding points emphasize the urgent need for preventive actions, primarily implemented through sex education programs [SEPs]. In many countries, especially in Latin America, these interventions predominantly occur within educational institutions (32) and are marked by an emphasis on oversimplified biological perspectives and traditional gender norms (32–34). However, ongoing efforts are underway to transition sex education towards mitigating inequalities by embracing a more inclusive approach to sexuality (32). In Chile, a law enacted in 2010 mandated sex education within public schools and high schools (35). Consequently, schools are required to deliver sex education either by contracting a program from an external institution or by developing their own. Most of these interventions are internally developed by the school or the local authority (municipality), with only a small percentage of schools implementing an external program (36). Within these SEPs, a predominant risk-based approach is prevalent (37), prioritizing biological aspects, often to the detriment of other considerations (36).

In addition to this risk-based approach, there are two more perspectives in sexual education. The abstinence approach promotes delaying sexual activity until marriage, presenting it as the most effective way to prevent pregnancy and STIs (38, 39). Within this approach is abstinence-plus, which also teaches about sexual healthcare methods (40). On the other hand, the comprehensive approach encompasses various interventions that share common features such as the incorporation of abstinence and sexual self-care methods, a human rights and gender perspective, and coverage of biological, psychosocial, spiritual, and value-based topics (39, 41–49).

Some studies have shown that abstinence-plus SEPs can increase knowledge about sexuality, reduce the risk of STIs, and enhance self-efficacy (40, 50). However, meta-analyses, systematic reviews, and other studies have demonstrated that abstinence-focused interventions -compared to comprehensive interventions- are largely ineffective, as they have limited success in promoting abstinence and preventing pregnancies (38, 47, 51–53). Additionally, these programs fail to meet the needs of sexually active adolescents, reinforce gender stereotypes, and contribute to stigma and mental health challenges for lesbian, gay, bisexual, and transgender [LGBT] youth (54, 55).

In contrast, evidence indicates that more effective SEPs are characterized by a comprehensive approach, as they not only

Abbreviations

STIs, sexually transmitted infections; LGBT, lesbian, gay, bisexual, and transgender; SEPs, sex education programs; FGTHP, the framework for gender-transformative health promotion.

augment knowledge about sexual health but also demonstrate effectiveness in reducing rates of STIs and unintended pregnancies, delaying the onset of sexual intercourse, and positively impacting mental health (16, 38, 47, 48, 56–59). Furthermore, they can help prevent partner violence, reduce homophobia, improve access to sexual health information, and increase confidence in discussing sexual topics (58, 60–62).

However, despite these positive outcomes, further research is essential to evaluate the impact of comprehensive interventions on vulnerable groups and the integration of gender-related elements (59, 63, 64). Additionally, in middle- and low-income countries, significant gaps persist in the development and implementation of SEPs, accompanied by a scarcity of experimental research (32, 64–66).

The importance of gender within sex education is highlighted in contexts where gender inequality is deeply ingrained (67). Outcomes of such interventions may detrimentally impact the sexual and mental health of adolescents (68), contributing to gender inequity in health. Certain programs may disproportionately benefit heterosexual adolescents over their LGBT counterparts (69, 70); and some programs inadvertently reinforce gender stereotypes of boys and girls and/or foster stigma in LGBT adolescents, leading to mental health difficulties (54, 55, 71). This issue is pronounced in numerous countries, including in Latin America (33). Therefore, there is a need for SEPs that promote gender equity, which is achieved through interventions that actively challenge detrimental gender norms, promoting more balanced gender relations (72) as everyone, regardless of gender, has the right to equal access to health, well-being, and structures providing health services (73).

In this context, design guidelines for SEPs recommend adopting a gender-transformative approach that emphasizes empowerment and gender equity in relationships (74). The Framework for Gender-Transformative Health Promotion [FGTHP] promotes this, asserting that interventions should prioritize transforming gender roles, relations, and practices, aiming for both health-improving and transformative outcomes to address harmful gender norms (75, 76). This framework facilities the exploration of health promotion strategies grounded in gender ideologies, discriminatory behaviors, and avenues for improving public health, while reshaping gender norms, roles, and relations through the intervention (77). Within this study, the FGTHP will guide the examination of evidence regarding individuals, context, and the issue through a gender lens.

On the other hand, designing health-promoting SEPs requires evidence-based, locally tailored approaches (64, 78). Intervention Mapping [IM] is a suitable framework, offering an ecological-systemic perspective, evidence-based foundations, and a participatory methodology to align with the needs and context of the target population (79). The effectiveness of IM is evident in its application to various sex education interventions (80–83) following some or all of its 6-step protocol (84). These steps involve developing Logic Models for Problem and for Change, selecting theory-based methods, crafting an Intervention Logic Model, determining program structure and content, creating an implementation plan, and establishing an evaluation plan to assess program outcomes.

In summary, this background underscores the need for evidence-based preventive interventions focused on sexual health in adolescence, with a proven efficacy of a comprehensive sexual education approach. Additionally, it is recognized that addressing gender within SEPs is crucial for achieving equity in health, particularly given the unique challenges faced by low and middle-income countries, where sex education often follows traditional gender perspectives and lacks comprehensive interventions. Hence, the aim of this research is to design a comprehensive, gender-transformative sex education program to contribute to health equity in adolescents. This will be achieved by implementing the first four steps of IM in conjunction with the Framework for Gender- FGTHP as key methodologies.

2 Method

This study employs an exploratory sequential mixed-method design, starting with qualitative data collection followed by quantitative assessment (85). The variant "intervention design" was utilized, where qualitative insights guided the development of a meaningful program for participants, subsequently evaluated quantitatively (85).

This process unfolded in two phases (see Figure 1): the first involved a literature review and qualitative data collection for intervention design through focus groups and interviews. The second phase encompassed validation of the intervention design (*via* expert judgment) and a preliminary evaluation. Throughout these phases, steps one to four of the IM framework were implemented.

2.1 Phase I: intervention design

2.1.1 Participants

A typical case sampling method was employed (86), selecting participants based on their potential to provide information on SEPs.

To choose participants, six public high schools were selected in collaboration with the Santiago Municipality's Department of Education, which oversees these institutions. The sample included three co-educational high schools, one single-sex boys' high school, and two single-sex girls' schools. These schools serve students from middle- and low-income backgrounds, many of whom come not only from Santiago but also from nearby cities. Two of these high schools offer technical training in the last two years of study, while the others provide a liberal arts and sciences education. Additionally, there is a significant percentage of students from other countries.

The inclusion criteria for professionals were as follows: they had to be responsible for the SEP at their school or have implemented sex education activities within the past year. All professionals in charge of the SEP at their school were invited to participate, and everyone accepted ($n = 6$). One teacher from each school was also invited to be part of the study. All accepted to participate, and two additional teachers who showed interest

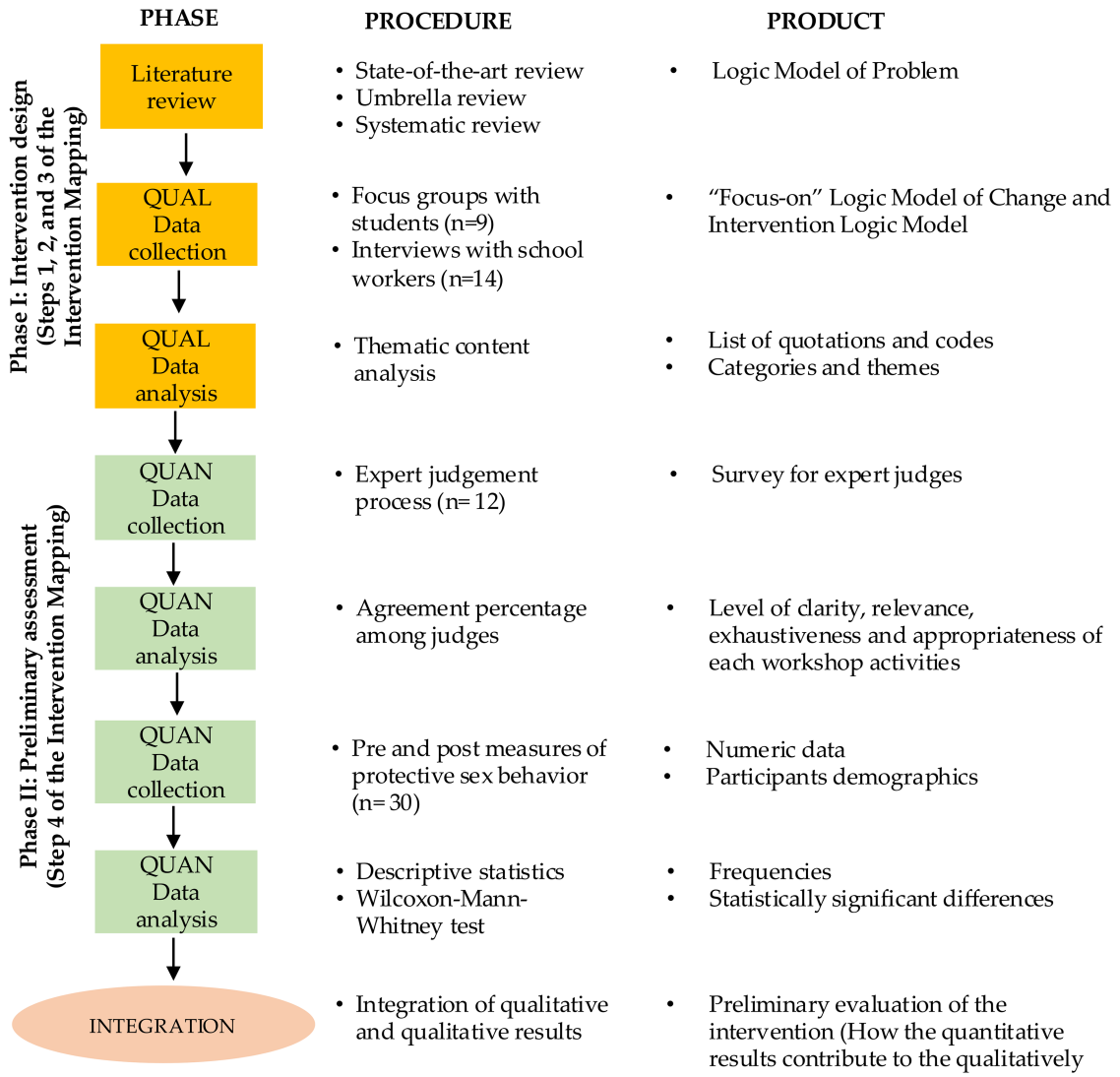

FIGURE 1
Design of the study (85).

were included as well ($n = 8$). Thus, 14 school professionals were involved in this phase.

For students, the inclusion criteria specified that they must be first- or second-year high school students who participated in sexual education activities in the past year and have obtained informed consent from their parents. A general invitation to participate in the study was extended to all first- and second-year high school students at the participating schools, resulting in 56 students agreeing to take part, representing a range of sexual orientations and gender identities.

- The distribution of students in each focus group was based on their available schedules, resulting in different numbers and compositions of participants for each group. There was no separation by gender in the coeducational high schools, as the research team prioritized grouping students according to their scheduling preferences. The composition of each focus group was as follows:
  - Single-sex girls' schools: (i) nine female students, (ii) seven female students, (iii) four female students, (iv) six female students
  - Single-sex boys' high school: (v) four male students, (vi) six male students, and one student who identified as a transgender woman
  - Co-educational high schools: (vii) seven students (two male and five female), (viii) six students (three male and three female), (ix) six students (four male and two female)

2.1.2 Data collection techniques

Nine focus groups with students and 14 interviews with professionals were conducted. The dimensions addressed in both techniques included sexuality needs for adolescents, components of a

school-based sexual intervention, methodological considerations, and relevant topics. Examples of the interview and focus group guide can be found in Supplementary Material 1.

2.1.3 Analysis

A content analysis was conducted using categories derived from empirical data (87). To accomplish this, the thematic content analysis procedure proposed by Díaz Herrera (88) was adhered to, entailing category configuration, development of category trees, category validation, and identification of central themes.

2.1.4 Procedure

During Phase I, steps one, two, three, and part of four of the IM were implemented. In step one, a needs assessment was carried out to construct a Logic Model of the Problem. This assessment started with a state-of-the-art review and an umbrella review, focusing on adolescent sexuality, SEPs, and topics pertinent to comprehensive interventions. Health equity aspects, particularly those related to gender equity, were emphasized in the search. Then, information from a systematic review previously conducted by the team (documented in a separate publication) was incorporated. The obtained information informed the Logic Model of the Problem and the script for interviews and focus groups.

Subsequently, professionals signed informed consent forms. Parents provided consent through one of the following methods: (i) during parent meetings at the school, where the research team explained the study, or (ii) individually, with the teacher explaining the study to the parents. During this process, approximately 10% of parents did not authorize their children's participation due to religious beliefs or disagreements with the gender approach. Afterward, the team visited students at the high schools to explain the study and obtain their assent.

Next, interviews and focus groups were conducted, and the information underwent content analysis. By integrating insights from the literature review, focus groups, and interviews the problem was delineated, and its personal and environmental determinants were identified, leading to the development of the Logic Model of the Problem.

Step two involved developing the Logic Model of Change, outlining program outcomes, and examining theoretical models identified through the systematic review. In this process, the personal and contextual factors (identified in the Logic Model of the Problem) that could be addressed through the intervention were selected.

Finally, step three involved selecting theoretically and empirically based methods, practical applications, and intervention components through a systematic review, in conjunction with results from qualitative techniques. This informed the Intervention Logic Model, specifying program structure, topics, workshop sessions, and activities. Additionally, performance objectives were developed to address the personal and contextual determinants.

2.2 Phase II: validation and preliminary evaluation of the intervention

2.2.1 Participants

The expert judgment involved 12 professionals who met specific criteria, including academic backgrounds in Education or Psychology, experience within educational communities, and previous involvement in sex education interventions or research. The professional cohort consisted of Teachers, Psychiatrists, Social Workers, a Stakeholder, Nurse-Midwives, Psychologists, and an Educational Psychologist.

In the preliminary evaluation a non-probabilistic sampling approach was utilized. The student cohort comprised 30 first- and second-year students from two public high schools in Santiago, Chile, averaging 15.1 years of age (SD = .923). Of these, 66.7% were Chilean, with 53.3% not affiliating with any religious belief and 29.9% identifying with a religion (Catholic, Protestant, or Mormon). In terms of gender identity, 50% identified as women, 40% as men, and 10% specified other identities (e.g., gender fluid, he-she). Regarding sexual orientation, 66.7% identified as heterosexual, 13.3% were undefined, 10% as bisexual, and 10% indicated other orientations (e.g., pansexual, aromantic). Participants were presented with various gender identity and sexual orientation options, with reported percentages reflecting adolescents' selections.

2.2.2 Measures and data collection

An intervention validation survey was developed for expert judgment, comprising four dimensions evaluated dichotomously (Yes-No) for each session activity: (i) Precision—clarity for effective implementation by facilitators; (ii) Relevance—contribution to achieving objectives; (iii) Comprehensiveness—inclusion of sufficient elements aligned with theoretical foundations; (iv) Adequacy—appropriateness for the participants. Experts provided qualitative feedback, including suggestions for improvement.

For the preliminary evaluation, an ad-hoc survey measured protective skills in sexuality, defined for this study as actions or intentions aimed at preventing STI and unintended pregnancies, while enhancing factors associated with sexuality-related empowerment. The survey utilized seven Likert-scale items (from strongly disagree to strongly agree), where a higher score indicated better protective skills in sexuality. This scale was derived from the literature and instruments used in similar studies sharing the same intervention theoretical foundation, as seen in works by Constantine et al. (57), Coyle et al. (89), and Manaseri et al. (90).

2.2.3 Data analysis

The expert judgment results were evaluated based on the percentage of agreement among judges for each activity across sessions. Activities with less than 70% agreement were adjusted according to judges' guidelines.

The survey's reliability was assessed using McDonald's Omega coefficient, which is suitable for ordinal-level variables due to its

sensitivity and unbiased estimation (91–93). Scale interpretation considered values above.90 as excellent,.80 as good, and.70 as acceptable (94). Data distribution was evaluated using the Shapiro-Wilk test (95). Subsequently, the Wilcoxon–Mann–Whitney test (96, 97) compared pre- and post-intervention protective skills in sexuality across 30 paired observations, with significance determined at the.01 level to check whether the median difference between the pre and post was statistically significant. All analyses were performed using Jamovi version 2.3.18.0.

2.2.4 Procedure

During this phase, part of step four of the IM was executed (production and pre-testing of the program). The expert judgment process was conducted online. An email was sent with details about the process and program sessions relevant to each expert's area of expertise, ensuring a minimum of three reviewers per session. Experts were then asked to complete an intervention validation survey via an online platform, accompanied by an instructional video explaining the program design process and evaluation instructions. Adjustments to the sessions were implemented based on the recommendations provided by the expert judges.

Following this, a preliminary program evaluation was conducted by implementing it in a small sample from the target population across two high schools within the demographic. Parents provided informed consent, followed by assent from students who completed an entry survey. Workshops were facilitated by two teachers in each high school—two Mathematics teachers, one English language teacher, and Biology teacher—following training from the research team. The 10 sessions occurred weekly during class time. Upon completion of the intervention, an exit survey was administered to the students.

2.3 Ethical considerations

The study was conducted with the authorization of the Universidad de Chile Social Sciences Ethics Committee, which is accredited by the Regional Ministry of Health. Participation was voluntary and confidential. Expert judges and parents provided signed informed consent forms, while students provided signed assent forms. The characteristics of the study and the assurance of participants' rights were ensured and were explicitly outlined in the consent and assent forms.

3 Results

3.1 Phase I: intervention design

3.1.1 Literature review

The comprehensive analysis, combining the state-of-the-art and umbrella reviews, identified key personal and environmental factors influencing the intervention's main concerns: sexual risk behavior, gender inequity in sexual health, and mental health issues linked to sexuality. The literature review underscored key elements such as behaviors conducive to positive adolescent sexual health, contributors to favorable mental health outcomes related to adolescent sexuality, and promoters of gender equity in adolescent sexual health. Detailed citations for these studies are provided in Supplementary Material 2.

These results facilitated the creation of the Logic Model of the Problem (Supplementary Material 3). This model provides a detailed depiction of the concerns addressed in the intervention by emphasizing the individual determinants involved. These determinants encompass factors such as knowledge, attitudes, risk perception, or skills that are correlated with or could potentially impact adolescent risky sexual behavior (98). Additionally, it outlines specific behaviors linked to this issue and their repercussions on adolescent health.

Additionally, the results of the systematic review (99), provide information for the subsequent design of the Logic Model of Change. These results highlighted that the majority of SEPs were grounded on behavioral change theories, primarily Ajzen's Theory of Planned Behavior (100) and Ajzen & Fishbein's Theory of Reasoned Action (101). Additionally, a substantial percentage of interventions drew from two or more theoretical frameworks. Key insights from this review include the prevalence of comprehensive approaches, participatory methodologies, and the importance of facilitator training. While no standardized dosage was identified, most interventions entailed a minimum of 10 h of weekly delivery.

3.1.2 Focus groups and interviews

The content analysis identified key themes across three dimensions, outlined in Table 1. Within dimension one "Components of a sexual intervention for adolescents," emerged themes included: (i) specific facilitator guidance, (ii) extended intervention time, and (iii) facilitator training. Dimension two "Relevant topics for the intervention" encompassed: (i) STI and pregnancy prevention methods, (ii) gender dynamics, (iii) LGBT issues, (iv) intimate partner violence, and (v) emotional aspects. Finally, dimension three "Methodological considerations" highlighted: (i) the implementation of participatory strategies and (ii) utilization of dynamic activities. In summary, the findings underscored the importance of facilitator training, structured interventions, participatory methodologies, tailored content for LGBT students, integration of gender equity principles, and adaptation of a multidimensional approach to sexuality education.

3.1.3 Final design of the intervention

Drawing on literature review insights and focus group/interview outcomes, the "Focus-on" Logic Model of Change was developed (see Supplementary Material 4). Although various personal and environmental determinants were identified in the Logic Model of the Problem, priorities were established in developing the Model of Change, focusing only on those considered most relevant by the literature and by the target population. For example, the key personal determinants selected for intervention efforts regarding risky sexual behavior include sexual health knowledge and risk perception.

TABLE 1 Central themes identified in focus groups and interviews.

Dimension	Central themes	Description	Quotes
Components of a sex education intervention for adolescents	Specific guidelines for facilitators	School professionals underscore the necessity of an intervention handbook encompassing activities for each session. This would alleviate their workload, given their typically overwhelming responsibilities. Moreover, it would facilitate standardization in curriculum delivery, irrespective of the personal beliefs or values of facilitators, who are predominantly teachers in most high schools.	"I think that in general, the teachers' community needs support… because there are many opinions expressed from popular knowledge, that is, from knowledge from their communities of origin, family, etc., but to say something like a contribution with serious knowledge I think we need… many times teachers are asked for many things… but teachers… do not have the tools, and they are being asked to comply with something without having the tools. So, I think it is important to provide them with those tools so that they can consciously apply them"(Teacher, co-educational high school)
	Increased intervention time	Both professionals and students identify multiple topics necessitating inclusion, highlighting the need for an extended intervention to adequately address these subjects.	"I would like there to be more classes and more discussion" (Student, single-sex girls' high school)
	Training for facilitators	Not all professionals are knowledgeable in the subject matter; hence, training is essential to bolster their confidence in conducting the intervention.	"(It is necessary) to train teachers about the topics… because as I said, they can give orientation on several topics…, but the topic of sexuality is difficult for them" (Sex education program manager, single-sex girls' high school)
Relevant topics for intervention	STI and pregnancy prevention methods	Adolescents require scientific and up-to-date information to prevent STI and unwanted pregnancies	"Because I feel it is important, it is important to have biological and emotional sex education because if not, what will happen in the future? We won't know what diseases are transmitted, and some don't even know how to put on a condom; they don't know that they must press up… They pull down everything hard… it is clear evidence that we have a poor education respectively" (Student, single-sex boys' high school)
	Gender Relations	Students and school professionals stress the importance of addressing sexism and gender discrimination	"I think it has to do with the appropriation of essential issues so that we can take it to the school environment. That is, it has to do with coexistence, that everyone has the floor, I don't know, that in a co-educational class, we don't give the floor only to the boys and not to the girls, that we take some to the blackboard and not others" (Teacher, single-sex girls' high school)
	LGBT Community	Adolescents particularly emphasize the need for an intervention that is inclusive and does not adhere to heteronormative standards, but instead incorporates topics pertinent to LGBT adolescents.	"I think that something that should be talked about is the topic of sexual orientations and genders. Because as they said before, it is not something that is talked about… so I think it would be important for it to exist, and for example, respect for, I don't know, pronouns, social names, and those things" (Student, single-sex girls' high school)
	Intimate Partner Violence	Adolescents and professionals highlight the need to include tools to prevent and address intimate partner violence.	"Generally, more is said about sexuality on the heterosexual side, so there is a lack of information for people who are homosexual, lesbian or bisexual, or have a different orientation" (Student, co-educational high school)
	Affectivity	It should encompass a multidimensional perspective of sexuality, incorporating aspects of affectivity and mental health.	"There are still practices such as violence in the couple's relationship, which is an issue that we have to address now. There is still a lot of violence in the couple… as a relationship of domination, and the objectification of women, the "you are mine", that happens a lot here" (Teacher, co-educational high school teacher)
Methodolo-gical considerations	Participato-ry strategies Interactive and fun activities	Students demand activities that enable them to take on leading roles within the intervention and cultivate their skills. Adolescents exhibit higher motivation when engaging in dynamic activities that offer enjoyment. This environment fosters learning and enhances adherence to the intervention.	"So the teacher made a way to make it more participatory, more dynamic, and then she started with the circles and questions that interested us" (Student, co-educational high school) "It depends on the type of class, because for example sometimes we were given guides… and you think that's… boring, and other classes that had questions and we stood up, those were more entertaining" (Student, co-educational high school)

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Thus, specific objectives were developed in the Logic Model of Change aimed at addressing both personal and environmental determinants targeted by the intervention. It is important to note that these objectives were based on the selected theoretical framework, with the main foundation for "Focus-on" being the Theory of Planned Behavior (100).

This theory suggests that the intention to perform a behavior predicts subsequent behavioral change and that this intention comprises three cognitive variables (attitudes, subjective norms, and perceived behavioral control) (102). Additionally, this intention is best assessed through short-term self-reporting (immediate post-intervention assessment), while behavior change is generally measured in the medium or long term (follow-up assessment) (100, 103). Therefore, the objectives and outcomes developed in the Logic Model of Change are centered on skills, behavior and behavioral intention. The preliminary evaluation is specifically geared towards assessing intention.

On the other hand, components addressing the environmental determinants of this model encompass relational facets of sexuality such as the mitigation of discriminatory behaviors. These aspects were determined to be addressed with adolescents during workshop sessions and with facilitators through training.

Ultimately, through the synthesis of the problem definition (Problem Model) and the objectives for its modification (Change Model), the Intervention Logic Model was established (see Figure 2). Drawing from the findings of the systematic review, the intervention strategies most endorsed by the Theory of Planned Behavior (as well as other incorporated theories) were selected to achieve the objectives proposed in the Model of Change.

Thus, the Intervention Logic Model outlines an evidence-based, health equity-focused intervention structured around three pillars: self-care in sexual health, gender equity in sexuality, and mental health and sexuality. The program was named "Focus-on" ("Enfócate", in Spanish) and includes:

- Facilitator training, which included the following topics: comprehensive approach to sex education, utilization of participatory methodologies in sexual education, adolescent mental health and sexuality, theory of emotion regulation, gender-sensitive perspective, Framework for Gender Transformative Health Promotion.
- Facilitator toolkit.
- High school workshops comprising 10 sessions with participatory activities, tailored to addresses identified needs collected through focus groups and interviews.

Theoretical foundations include the Theory of Planned Behavior (100), the FGTHP, and the Ecological Theory (104), supplemented by principles from the Social Cognitive Theory (105, 106), the Gross Model of Emotion Regulation (106), and the Transtheoretical Model of Change (107).

It's important to note that "Focus-on" can be integrated into preventive interventions targeting adolescents concerning various forms of risky behaviors. Given its comprehensive approach

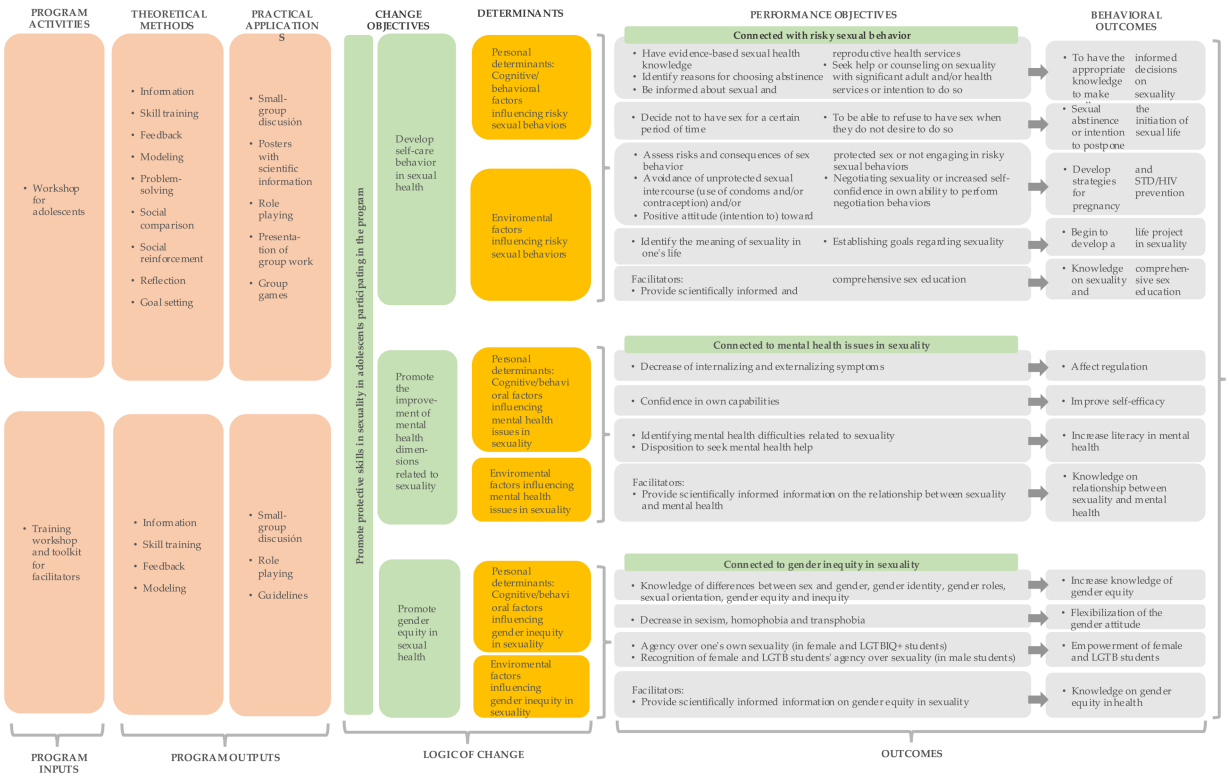

FIGURE 2
Intervention logic model (85).

sexuality, the program can address intersections with other interventions (e.g., drug and alcohol use, school violence, sexual abuse) within the framework of its thematic pillars. Thus, a substance abuse prevention program could contribute to sessions under the "Mental Health and Sexuality" pillar, making it possible to address this risky behavior as a determinant for sexual health while simultaneously fostering skills to prevent its occurrence among adolescents.

3.2 Phase II: preliminary intervention validation and evaluation

3.2.1 Validation of the intervention

Activities scoring below 70% agreement among the judges underwent modifications specific to the dimension that fell below this threshold (see Supplementary Material 4 for detailed results). These adjustments were aimed at enhancing the participatory nature of the activities, providing clear instructions to facilitate increased understanding among facilitators, and refining concepts to improve participant comprehension and encourage deeper reflections. Consequently, the final design of the sessions was refined, resulting in the completion of the sessions' blueprint, which is outlined in Table 2 for review.

Subsequently, for step 4 of the IM, the program sequence was outlined: facilitator training, toolkit distribution, and workshop implementation for students. The intervention toolkit comprises three handbooks: (i) "Guide 1: Workshop Implementation," detailing each session, (ii) "Guide 2: Focus-on Background," offering theoretical insights into workshop topics. (iii) "Guide 3: Sex Education Methodology for Focus-on," providing facilitators with methodological tools for conducting workshops with a participatory approach.

The toolkit content and graphic design prioritize cultural sensitivity and gender equity. For example, "Guide 1" incorporates relevant concepts and scenarios for the target population, while all guides use imagery free of gender stereotypes. "Guide 2" explores topics like "Gender and Adolescent Sexuality," while "Guide 3" includes guidelines for culturally sensitive facilitation and inclusive language regarding gender and disability.

3.2.2 Preliminary evaluation of focus-on

The reliability analysis of the ad-hoc survey initially employed the McDonald Omega coefficient to assess internal consistency. The coefficient yielded a value of $\omega = .8$ for the total scale within the sample utilized for this study, indicating good reliability (94). This suggests that the instrument effectively evaluates protective skills in sexuality across its scale items.

Upon further examination, the sample distribution demonstrated non-normality, as evidenced by the Shapiro-Wilk test results ($W =$ between .546 and .866; $p =$ <.05). Consequently, the Wilcoxon-Mann-Whitney test was employed to assess changes in protective skills in sexuality among adolescents participating in the program.

The descriptive results indicate an increase in preventive skills related to sexuality among the participants. In Supplementary Material 6, the means of the pre- and post-intervention surveys by demographic characteristics can be observed. Additionally, the Wilcoxon-Mann-Whitney test results revealed statistically significant differences between pre and post-tests of this outcome ($W = 58.5$, $p < .01$), indicating an increase in its level following the intervention. For detail findings, please refer to Table 3 and Supplementary Material 7.

A statistical analysis to identify statistically significant pre-post differences in protective skills in sexuality based on sexual orientation and gender identity could not be conducted due to the sample size. However, descriptive data before and after the intervention indicate that both participants identifying as cisgender and those identifying as non-cisgender showed an increase in their average score in protective skills in sexuality. The same trend was observed among heterosexual and non-heterosexual participants (this information can be viewed in Supplementary Material 8).

3.3 Next steps for "focus-on"

This study adhered to the IM guidelines for health promotion programs, completing up to step four of the process. Therefore, it's expected that future studies will address the remaining components of the next steps of IM. As such, the research team intends to formulate a plan for implementing and initially evaluating the program through a pilot randomized controlled trial. This pilot study aims to deliver the intervention on a small scale to assess various implementation aspects such as acceptability, feasibility, and preliminary results. These findings will inform refinements to design elements and procedural protocols for conducting a broader randomized controlled trial in the future, where the effectiveness of "Focus-on" and other implementation measures like adoption, adaptability, and fidelity will be assessed. This iterative process is recommended for the development of interventions across diverse health domains (108).

4 Discussion

Adolescence is a crucial period for sexual health, marked by intricate physical and psychological changes that can have profound impacts. Gender dynamics play a pivotal role in shaping adolescents' sexual behaviors and experiences (22, 109), and conventional gender norms embedded within sexual education interventions can perpetuate adverse outcomes, especially for LGBT adolescents (54, 55, 67, 68, 71). This highlights the importance of SEPs to address gender disparities and promote health equity, especially in low-income countries.

In response, this study aimed to design an SEPs tailored for adolescents, guided by the Intervention Mapping (IM) framework. Through intensive literature reviews, consultation interviews with educational professionals, and focus groups with high school students, we developed "Focus-on"- a comprehensive

TABLE 2 "Focus-on" workshop sessions.

Session	Pillar	Activities	Theoretical basis	Topics
1: Focus on expressing yourself	Introduction to the program	Activity 1: Presentation of the program Activity 2: Our rules Activity 3: Teamwork Activity 4: The circle of sexuality	The transtheoretical model of change/Theory of planned behavior (subjective norms)	• Introduction to the program • Creation of norms of harmony • Expression and validation of beliefs, values and expectations
2: Focus on your experience	Self-care behavior in sexual health	Activity 1: Who do I ask?	Theory of planned behavior (subjective norms)/Theory of reflective learning	• Adolescence and sexuality (biological components, normative changes) • How and where to obtain adequate information (significant adults, health networks) • Reflection on the role of social media.
		Activity 2: Roads	Theory of planned behavior (attitude)/The transtheoretical model of change/Theory of reflective learning	
		Activity 3: Myths & Truths	Theory of planned behavior (subjective norms)/Theory of reflective learning	
3: Focus on getting informed	Self-care behavior in sexual health	Activity 1: I get informed to decide	Theory of planned behavior (subjective norms)/Theory of reflective learning	• Reproductive System • Pregnancy, STIs and HIV and their prevention
4: Focus on who you are	Gender equity in sexuality	Activity 1: Team Game	Framework for Gender Transformative Health Promotion/Theory of planned behavior (subjective norms)/Social learning theory	• Gender as a determinant of health • Sexual orientation and gender identity • Gender stereotypes and norms • Masculinities
		Activity 2: Feel different	Framework for Gender Transformative Health Promotion/Theory of planned behavior (attitude)/Theory of reflective learning	
5: Focus on who you are	Gender equity in sexuality	Activity 1: Expectations	Framework for Gender Transformative Health Promotion/Theory of planned behavior (subjective norms)/Theory of reflective learning	• Gender attitude (self-perception and interpersonal relations) • Masculinities • Equitable gender relations: empowerment and respect
		Activity 2: Putting Gender Equity into Practice	Framework for Gender Transformative Health Promotion/Theory of planned behavior (attitude, perceived behavioral control)/Theory of reflective learning	
6: Focus on your well-being I	Mental health and sexuality	Activity 1: The mental health pyramid	Social learning theory/Theory of reflective learning	• Mental health, affectivity, and sexuality • Identification of mental health states • Asking for help in mental health
		Activity 2: Mental health and sexuality	Theory of planned behavior (attitude, perceived behavioral control)/Theory of reflective learning	
7: Focus on your well-being II	Mental health and sexuality	Activity 1: True or False	Cognitive-behavioral theory/Theory of reflective learning	• Identification and regulation of emotions that influence sexual decision-making
		Activity 2: Influencers	Cognitive-behavioral theory/Theory of reflective learning	
		Activity 3: Shape your emotions	Theory of planned behavior (attitude, perceived behavioral control)/Cognitive-behavioral theory/Theory of reflective learning	
8: Focus on making decisions	Self-care behavior in sexual health	Activity 1: In your shoes	The transtheoretical model of change/Theory of planned behavior (subjective norms, attitude, perceived behavioral control)/Theory of reflective learning	• Sexuality decision-making (values-pleasure-affectivity-peer pressure) • Risky and protective sexual situations and behaviors (face-to-face and online) • Abstinence and safe sexual experiences
9: Focus on making decisions	Self-care behavior in sexual health	Activity 1: Practicing strategies	Theory of planned behavior (perceived behavioral control)/Social learning theory/Theory of reflective learning	• Self-care strategies in sexuality
10: Focus on your life project	Self-care/Mental health/Gender equity in sexuality	Activity 1: Balancing my decisions	The transtheoretical model of change/Theory of reflective learning	• Life project associated with sexuality • How I arrived and how I am leaving
		Activity 2: My plan	Framework for Gender Transformative Health Promotion/Theory of planned behavior (attitude, perceived behavioral control)/Theory of reflective learning	
		Activity 3: Closing the workshop	The transtheoretical model of change/Theory of reflective learning	

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TABLE 3 Protective skills in sexuality pre- and post-intervention.

Outcome	*N*	Mean	Median	*SD*	*SE*
Protective skills in sexuality (pre)	30	25	25	4.94	.903
Protective skills in sexuality (post)	30	27	27	3.14	.573

SEPs comprising facilitator training, a comprehensive toolkit, and a ten sessions workshop. Following the implementation of the program in two high schools with a cohort of 30 participants, as part of the fourth step in the IM process, we observed a statistically significant increase in protective skills in sexuality among students ($W = 59$, $p = .01$). Furthermore, based on the pre-post descriptive data, it was observed that -irrespective of sexual orientation or gender identity- all participants exhibited improvements in this domain. Thus, this intervention addresses a spectrum of factors influencing sex health outcomes and positively influencing facets such as pregnancy and STI prevention, which is promising for enhancing protective skills in sexuality.

These findings, first and foremost, underscore that the adoption of IM steps in the development of "Focus-on" facilitated the integration of the most robust evidence available with the current needs of the target population. Consequently, an evidence-based program was developed, as a way to effectively address the recipients' needs while remaining culturally relevant, adapting to the contextual nuances of its implementation.

Furthermore, the mapping of personal and environmental determinants offers a holistic perspective of the intervention by considering both individual and contextual factors. This approach aligns with the multidimensional framework of sexuality embraced in the design of "Focus-on", which enables the identification of environmental influences on risky sexual behavior and address broader dimensions of sexual health beyond the biological realm. Consequently, the program not only targets individual factors but also equips adolescents to navigate challenges pertaining to sexuality within their environment. Additionally, while "Focus-on" includes a pillar dedicated to the biological aspect of sexuality (self-care), it incorporates two pillars aimed at fostering a comprehensive understanding of sexuality (mental health and gender).

Moreover, IM advocates for the integration of multiple theories in the design process, recognizing that synthesizing diverse theoretical perspectives facilitates and understanding of behavior change (98). This approach proved beneficial for the program's development, as while it predominantly draws from the Ajzen theory, it was augmented by additional frameworks essential for achieving the intervention's objective, such as the FGTHP framework, which enabled the gender-transformative approach of "Focus-on".

Finally, the systematic nature of intervention planning with IM is noteworthy. Each step of this methodology encompasses specific components, participants, and outputs, contributing to an organized process in program development.

All these observations echo prior research findings from, further underscoring IM's efficacy in cultivating stakeholder consensus, tailoring interventions to contextual needs, and facilitating adoption and implementation processes (80, 110, 111).

Another noteworthy aspect revealed by this study is the gender-transformative approach of "Focus-on" and its comprehensive consideration of mental health dimensions associated with sexuality, thereby contributing to both global and local contexts. This contribution is particularly salient as many SEPs incorporate gender elements inconsistently due to insufficient understanding or implementation skills (46, 112), impeding their ability to generate changes in the gender-related areas that could impact sexual health outcomes. In this regard, "Focus-on" delineates specific objectives and sessions aimed at fostering positive attitudes and equitable gender relations in adolescent sexuality. Consequently, the program exhibits the potential to advance gender-equitable outcomes within adolescent sex education, as evidenced by the observed increase in protective skills in sexuality among participants representing diverse sexual orientations and gender identities. This situation can be linked to the inclusion of content and materials that embrace sexual diversity. Thus, the use of brochures and images (utilized in all sessions for group work) free from gender stereotypes, activities to challenge these stereotypes, and the training guides for facilitators (which promoted gender equity and its implementation in the workshop) were crucial elements. These principles have been highlighted in other studies as relevant for a gender-transformative approach (56, 59).

In this sense, it is possible to hypothesize that participants had an intervention experience that aligned with their needs, as it included the perspective of the target population in the design during the qualitative phase of the study. Moreover, by incorporating a comprehensive view of sexuality based on various sexual orientations and gender identities, all participants felt included in "Focus-on", unlike gender-blind sex education programs that only benefit a specific group of adolescents (69, 70). These finding hold considerable significance, particularly in light of the potential shortcomings of SEPs lacking a gender-focused approach. Such inadequacies may diminish program effectiveness, exacerbate health issues, perpetuate gender stereotypes, evoke feelings of exclusion, and perpetuate stigma and discrimination (46, 113).

Similarly, the incorporation of mental health aspects within the intervention is noteworthy given their intrinsic connection to sexuality (8–12). Nonetheless, these dimensions receive comparatively less attention in sexual education initiatives (63), underscoring the need for programs capable of adequately addressing them.

Regarding strengths and limitations of this study, the main limitation pertains to the small sample size utilized for its preliminary evaluation, limiting the generalizability of results and precluding further statistical analyses regarding significant pre-post differences based on participants' sexual and gender orientations. Nonetheless, it's noteworthy that the sample size was deemed suitable for a preliminary evaluation. Conversely, a notable strength of the study lies in its innovative approach. The intervention adopts a comprehensive approach to sex education, with particular emphasis on addressing gender—a frequently-

overlooked aspect in this type of SEPs (114). By leveraging the FGTHP framework, "Focus-on" goes beyond mere inclusion of gender-related content; it actively promotes gender equity in health, addressing issues like sexism, intimate partner violence, new masculinities, and discrimination against LGBT adolescents. Furthermore, employing IM to design the intervention ensures the development of an evidence-based, theoretically grounded program tailored to the specific needs of adolescents and intervention facilitators.

On the other hand, further examination of various aspects of "Focus-on" implementation, including its acceptability, feasibility, and subsequent effectiveness, is imperative. This comprehensive analysis will serve to broaden the generalizability of result. Additionally, it is necessary to persist in evaluating the intervention's role in promoting gender equity in health. Finally, it is imperative to sustain ongoing evaluation of the intervention's contribution to promoting gender equity in health.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Universidad de Chile Social Sciences Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

BT-C: Conceptualization, Methodology, Writing – original draft, Investigation. LL: Conceptualization, Methodology, Writing – review & editing. KC: Methodology, Validation, Writing – review & editing. LG: Validation, Writing – review & editing.

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Conflict of interest

The authors declare that the study was conducted in the absence of any commercial or financial relationship that would constitute a potential conflict of interest. The funders had no influence on the development and decisions related to this study.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frph.2024.1447016/full#supplementary-material

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Risky sexual practice and associated factors among antiretroviral therapy attendees in public health facilities, Wolaita Zone, South Ethiopia: a multi-center cross-sectional study

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Background: The majority of people living with Human Immunodeficiency Virus (HIV) are in low- and middle-income countries, particularly in sub-Saharan Africa. Increased risky sexual practice puts people living with the human immune virus at higher risk of acquiring sexually transmitted infections other than the human immune virus and unplanned pregnancies. Sexually transmitted infections, particularly viral hepatitis (B and C), significantly impair antiretroviral therapy and the clinical outcome of the co-infected individual, leading to increased morbidity and mortality. The purpose of this study was to investigate the prevalence of risky sexual practices among antiretroviral therapy (ART) attendees in public health facilities within the Wolaita Zone of South Ethiopia.

Methods: From September to October 2023, a facility-based cross-sectional study was conducted among adult people living with HIV on ART in the Wolaita zone. Data was collected through a pretested and structured questionnaire. Six diploma nurses were trained to collect data. Systematic sampling techniques were used to select a total of 398 ART patients. Data were collected by Open Data Kit (ODK) and analyzed with SPSS Version 25. Binary and multiple logistic regression analyses were used. All the variables with a *P*-value of 0.25 associated with risky sexual practices are considered candidate variables. Multicollinearity was checked. The fitness of the model was tested by the Hosmer-Lemshow goodness of fit test. Finally, statistical significance was declared at a *p*-value of 0.05.

Result: A total of 398 respondents took part in this study. The prevalence of risky sexual practices in the past six months was 174 (43.7%) at 95% of the CI (38.9–48.7). The result of multiple logistic regression analysis showed that not disclosing HIV status (AOR = 1.8, 95% CI: 1.1–3.31), alcohol drinking (AOR = 3.1, 95% CI: 1.66–0.023), and poor social support (AOR = 1.9, 95% CI: 1.75–3.9) were statistically significantly associated with risky sexual practices.

Conclusion: This study revealed that the risky sexual practice among ART clients was high and disclosure status, social support, and alcohol use were factors associated with risky sexual practice. The governmental and non-governmental bodies have to strengthen social support for ART clients, disclosure status for ART clients, and counseling to avoid alcohol.

KEYWORDS

risky sexual practice, HIV, adults, ART, Ethiopia

Introduction

Risky sexual practices are defined as inconsistent and/or no condom use with a partner who is HIV-negative or has an unknown sero-status (1). According to 2023 UNAIDS report, 39 million people were living with HIV globally and sixty-five percent of people living with HIV (PLHIV) reside in sub-Saharan Africa (2). Ethiopia is one of the sub-Saharan countries that is worst affected by the HIV/AIDS pandemic. In 2019, the national HIV prevalence was estimated to be 0.9% (3). Increased risky sexual behavior puts PLHIV at higher risk of acquiring sexually transmitted infections (STIs) other than HIV and unplanned pregnancies; it has been reported that STIs, especially viral hepatitis (B and C), have a significant negative impact on ART and the clinical outcome of the co-infected person, including increased morbidity and mortality (4).

Ethiopia is primarily focusing on people uninfected with HIV and the sexual risk practices of HIV-infected individuals who did not receive due attention (5).

HIV/AIDS remains a major public health problem. According to UNAIDS global statistics, about 37.7 million [30.2 million–45.1 million] people worldwide were living with HIV, and 1.5 million people became newly infected with HIV in 2020. About 27.5 million people were taking antiretroviral therapy (ART), and an estimated 680,000 people died from AIDS-related illnesses in 2020 (1).

Globally, unprotected sex among HIV-positive people on ART became one of the problems that aggravated HIV transmission. The worldwide focus of HIV prevention efforts was largely on people who were uninfected with HIV/AIDS, but the sexual behavior of HIV-infected persons did not receive any serious attention for a variety of reasons (2). Evidence shows that 20%–80% of people living with HIV/AIDS continue to engage in risky sexual practices in sub-Saharan countries (3). Study conducted in Addis Ababa, Ethiopia showed that risky sexual practices that may further transmit the virus put them at risk of contracting secondary sexually transmitted infections and lead to problems with drug resistance (4).

Initially, a diagnosis of HIV infection counted as a death sentence. In that context, the sexual life of those infected persons seemed a secondary issue, which made prevention focused on sexual behavior hard to imagine. Furthermore, the conviction that stigmatization should be avoided also precluded an interest in the sexual behavior of HIV-infected persons (1). Although many HIV-infected individuals avoid risky sexual practices, substantial numbers of them continue to engage in HIV-transmission-risk behaviours, which puts them at risk of reinfection by HIV strains resistant to ARV drugs or acquiring other sexually transmitted diseases (STDs), which hasten AIDS progression (2).

The majority of people newly infected with HIV in sub-Saharan Africa are infected during unprotected heterosexual intercourse (including paid sex) and onward transmission of HIV to newly born and breastfed babies. Having unprotected sex with multiple partners remains the greatest risk factor for HIV acquisition in this region (3).

Risky sexual practice among people receiving ART is an area of concern; hence, it is the major effective driver of the HIV epidemic. Among people living with HIV (PLHIV), these behaviors are common and potentially expose their partners to a risk of disease; for HIV-positive partners, these habits expose them to a real risk of infection by other strains of IV (4). Risky sexual practice among people receiving ART is an area of concern; hence, it is the major effective driver of the HIV epidemic. Among people living with HIV (PLHIV), these behaviors are common and potentially expose their partners to a risk of disease; for HIV-positive partners, these habits expose them to a real risk of infection by other strains of HIV. The magnitude of unprotected sexual practice among PLHIV is high in sub-Saharan Africa; more than 1 in 3 PLHIV were engaged in risky sexual practice (5).

Early sexual debut, multiple sexual partnerships, limited and inconsistent condom use, sex under the influence of alcohol, childhood marriages, and transactional cross-generational sex are the main risky behaviors currently driving the HIV epidemic in Ethiopia (6). Risky sexual practices increase the risk of HIV/AIDS, unintended pregnancy, unsafe abortion, and psychosocial problems (7). Therefore, the purpose of this study was to investigate the prevalence of risky sexual practices among antiretroviral therapy (ART) attendees in public health facilities within the Wolaita Zone of South Ethiopia.

Abbreviations

ART, anti-retroviral therapy; HAART, highly active anti-retroviral therapy; HIV, human immune virus; HIV/AIDS, human immune virus/acquire immune deficiency syndrome; ODK, Open Data Kit; PLWHA, people living with HIV AIDS; SNNPR, South Nations and Nationalities People Region; SPSS, Statistical package for Social Science; STI, sexual transmitted infectious; UNAIDS, United Nations Programmed on HIV/AIDS; WHO, World Health Organization.

Methods and materials

Study design and setting

An institution-based cross-sectional study was conducted from September to October 2023 in Wolaita zone, South Ethiopia, at a distance of 328 km from the capital city of the country, Addis Ababa, and 151 km from the regional capital city of Hawassa. There are about 67 health centers, six primary hospitals, and one comprehensive hospital. And there are 5,502 health workers in the Wolaita zone. There are about 18 ART sites. The total number of PLHIV currently on ART in the zone is 4,174.

Source population

The source populations were all adult ART attendees in public health facilities in Wolaita Zone.

Study population

Systematically selected ART attendees who were found in randomly selected public health facilities in the Wolaita zone.

Inclusion criteria

ART attendees in the age group ≥18 years who have been practicing sexual activities in the past six months were included in the study.

Exclusion criteria

Those who are seriously ill and unable to communicate verbally were excluded from the study.

Sample size determination

The sample size for the study was calculated by using single population proportion formula considering 95% level of confidence, 5% margin of error and 10% non-response rate, the proportion of practice is 40.9% (1). For finite population we use correction formula ($N < 10{,}000$) $\frac{n}{1+\frac{n}{N}} = 372/(1 + 372/4174) = 342$ after adding non-response of 10%, the final sample size calculated was 403.

Sampling technique

First, 30% of health facilities were selected from all health facilities that provide ART service to ensure representativeness of all health facilities after stratification by hospital and health center. Accordingly, six health facilities (2 hospitals from 7 to 4 health centers from 11) are randomly selected. Then, the calculated sample size ($n = 403$) was proportionally allocated to selected health facilities. We used systematic random sampling method to select the study participants until the allocated number of participants in each selected health facility is reached or obtained. The sampling interval was determined based on the number of patients who came for follow-up to the ART clinic each month. The average number of patients who came to the ART clinic for follow-up during the study period was estimated at 1,187. By considering the monthly client flow for follow-up, the sampling interval was two.

Data collection procedures and quality assurance

A structured questionnaire was developed to collect socio-demographic data, relationship-related factors, social-related factors, and behavioral factors. The client chart was reviewed to get data about medically related factors. Trained six diploma nurses collected the data. The questionnaire was prepared in English and translated into the Wolaitgna language. To check whether the translation was consistent with the language, the questionnaire was back translated to English by another language expert. A pre-test was done in 5% of ART patients in the study area, which would not be included in the actual study, to assess the content and approach of the questionnaire, and necessary adjustments were made before actual data collection. The questionnaire was also tested for internal consistency (reliability) by Cronbach's alpha test. The reliability coefficients for attitude and knowledge items had Cronbach's alpha of 0.841 and 0.701, respectively. The completeness, consistency, and accuracy of the collected data were examined by the principal investigator on a daily basis.

Training of supervisors and data collectors was given for one day before data collection. They were given information on ethical issues such as the need to observe confidentiality and obtain informed consent from participants prior to administering study tools. The overall supervision of data collection process was done by the principal investigator. Meetings were held to address problems and clarify issues that hampered the collection of good data with assistants who were found to have problems.

Data entry & analysis

The data was collected by ODK and exported to SPSS 25 statistical software for analysis. After cleaning the data in SPSS for inconsistencies and missing values, descriptive statistics were done. All the variables with *P*-values of 0.25 and risky sexual practices in the bivariable analysis were candidates for the final multivariable logistic regression model. Multi-Collinearity was checked using the Variance Inflation Factor (VIF); values 10 were included in the model. The fitness of the model was tested by the Hosmer-Lemshow goodness of fit test (*p*-value of 0.05). In the multivariable analysis, a value of *P* 0.05 was considered statistically significant. An adjusted odds ratio (AOR) with a 95% confidence level would be used to show the strength of association between dependent and independent variables. Finally, the result was presented through narration, tables, and figures.

Study variables

Dependent Variable

- Risky sexual practice.

Independent variables

Socio-demographic characteristics, relationship factors, behavioral factors, medical related factors knowledge and attitude on HIV transmission, prevention, condom use and others social support factors.

Operational definitions

Risky sexual practice

Having one or more of the following practices during the past six months prior to the date of data collection: having multiple sexual partners, casual sex, sex with out or inconsistent use of a condom even with a regular partner, sex with the influence of a substance like alcohol, khat (5).

Casual sex

Defined as sexual behavior that occurs between people who are not romantically involved and suggests a lack of emotional attachment, commitment, or familiarity. Examples include having sex while casually dating, having one-night stands, prostitution, swinging, and having friendships with benefits or sporadic sexual behavior that takes place outside of a committed partnership (8, 9).

Knowledge

To assess the level of knowledge, respondents who score greater than or equal to the mean are considered to have good knowledge, and those who score less than the mean are considered to have poor knowledge.

Attitude

To assess the level of attitude, respondents who score greater than or equal to the mean are considered to have a good attitude, and those who score less than the mean are considered to have a poor attitude.

Social support factors

Social support was measured using the OSLO 3-item social support scale. The sum score ranges from 3 to 14, with high values representing a strong level and low values representing a poor level of social support. The oslo-3 sum score can be broken down into three types of social support: 3–8 poor social support, 9–11 moderate social and 12–14 strong social support.

Result

The study was conducted on 398 participants, including adult ART attendants from 4 selected public health centers and 2 hospitals, with a 99% response rate. The results mainly fall into two categories: the status of risky sexual practice and associated factors.

Socio demographic characteristics

The majority of ART attendees, 309 (77.6%), were female. The age interval of 30 to 39 years accounts for 188 (47.2%) of the entire ART population, and the mean age of respondents was 35 years with a standard deviation of 8 (358). The marital status of respondents was: 248 (62.3%) were married. Educational status respondents were 133 (33.4%) and 89 (22.4%), both of whom were able to read and write and attended primary school. Housewives made up 110 (27.6%) of ART attendants. Regarding the income of ART patients, the majority of respondents (222, or 55.8%) reported getting ≥3,000 Birr per month. The residences of 343 (86.2%) ART attendants were urban. One hundred ninety-nine (49.7%) and 154 (38.7%) were protestant and orthodox followers, respectively (Table 1).

Assessment of medical related factors

Majority respondents among ART attendants: 266 (66.8%) were ≥48 months in ART follow-up clinic. The CD4 count was 376 (94.5%), which was greater than 200 cells/m^3. In terms of condom use, 365 (91.7%) of respondents used condoms. Thirty-three (8.3%) used condoms before being confirmed HIV positive, and they had safe sex discussions with health workers. One

TABLE 1 Socio-demographic characteristics of ART patients Wolaita zone Ethiopia, 2023.

Variable		Frequency	Percent
Sex	Male	89	22.4
	Female	309	77.6
Age	18–29	78	19.6
	30–39	188	47.2
	≥40	121	30.4
Marital status	Single	66	16.6
	Married	248	62.3
	Divorce	35	8.8
	Widowed	49	12.3
Educational status	unable read and write	44	11.1
	able read and write	133	33.3
	Primary (1–8)	89	22.4
	Secondary (9–12)	88	22.1
	college and above	44	11.1
Occupation	Governmental	89	22.4
	house wife	110	27.6
	Merchant	77	19.3
	Private	78	19.6
	Farmer	33	8.3
	Others	11	2.8
Monthly income	<1,500 ($26)	132	33.2
	1,500–2,999 ($26–$52)	44	11.1
	≥3,000 ($52)	222	55.7
Residence	Urban	343	86.2
	Rural	55	13.8
Religious	Protestant	198	49.7
	Orthodox	154	38.7
	Muslim	33	8.3
	Catholic	13	3.3

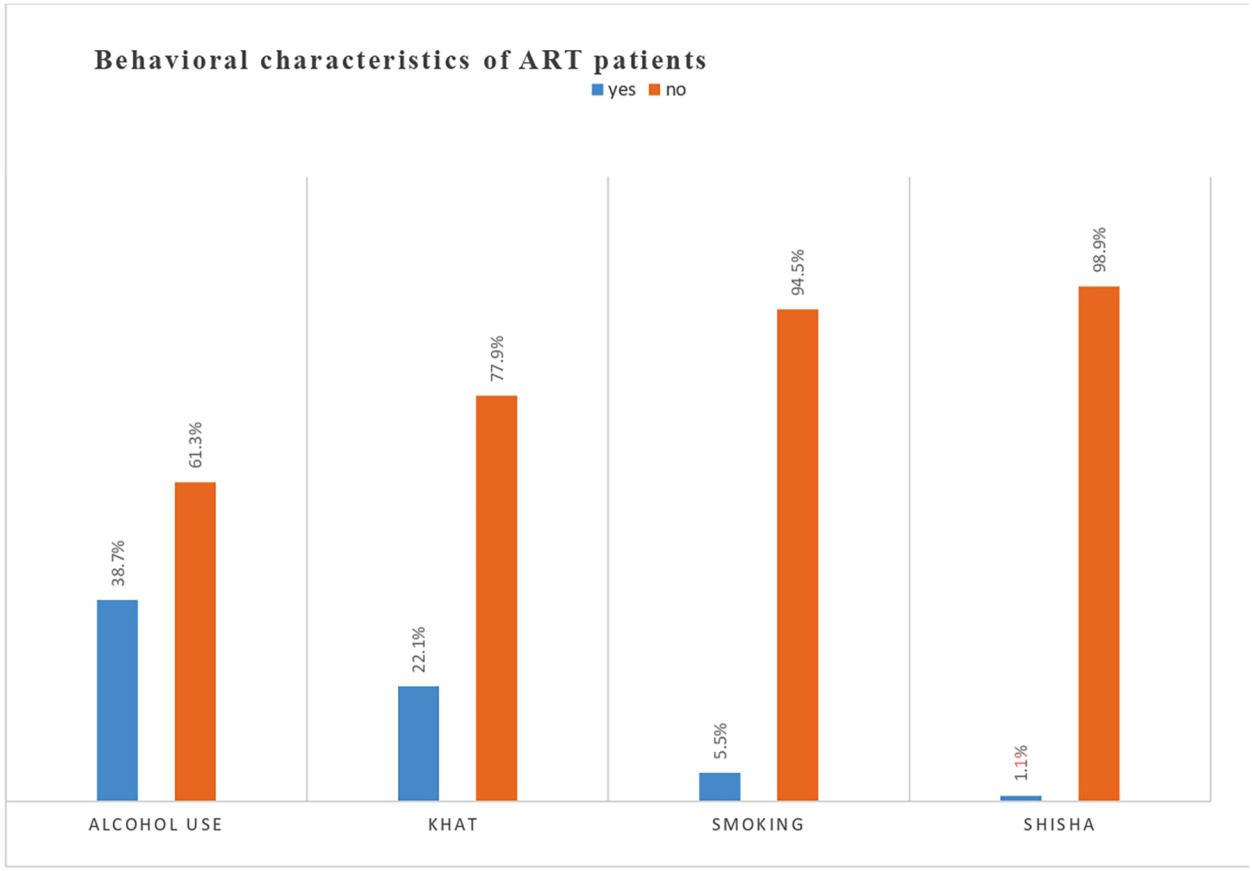

FIGURE 1
Behavioral characteristics of ART patients in Wolaita Zone, South Ethiopia.

hundred forty-three (34.9%) of the respondents disclosed their results to the community. Three hundred seventy-six (94.5%) respondents got counseling on the importance of protecting from new strain and received the risk reduction strategy. Of the total respondents, 55 (13.8%) also had an HIV prevention discussion or support group.

Assessment of attitude of ART patients

The result of the attitude assessment showed that more than half the respondents, 210 (52.8%), had a positive attitude for preventive aspects of risky sexual practices and 188 (47.2%), had a negative attitude for preventive aspects of risky sexual practices (Figure 1).

Behavioral factors

Of the 244 responders, the majority (61.3%) did not consume alcohol. In terms of khat use, 88 (22.1%) of those surveyed did so. Twenty-two people (5.5%) and four (1.1%) smokers of shisha were present (Figure 2).

Knowledge of ART patients

We assessed the knowledge of risky sexual practices of the participants by using seven items, five of the items were yes or no answer items and the rest two were items with choices with two and there options. According to the result of the assessment, 276 (69.3%) of respondents had good knowledge, while 122 (30.7%) of them had poor knowledge (Table 2).

Risky sexual practice among ART attendants

This study revealed that from the total of 398 ART participants, 174 (43.7%) ART patients practiced risky sexual practice and 224 (56.3%) didn't practice risky sexual practices. From the total of 398 ART patients, 159 (40%) had sex without a condom, 33 (8.3%) had sex under the influence of alcohol which was relatively less frequent compared with other risky sexual practice, 132 (33.2%) ART patients have multiple sexual partner, 110 (27.6%) had causal sex and 99 (24.9%) used condom consistently with partner.

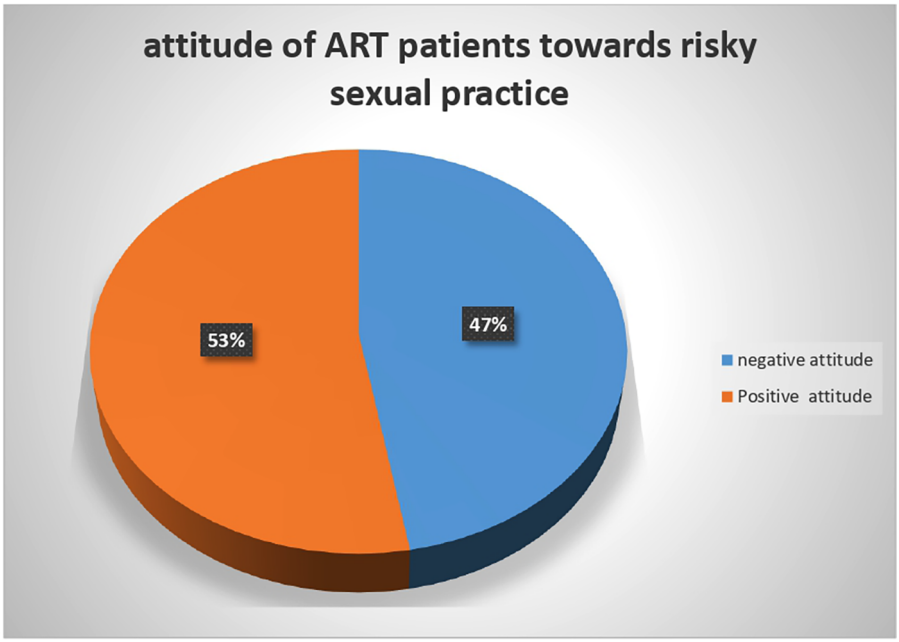

FIGURE 2
Attitude of ART attendees towards risky sexual practice in Wolaita Zone, South Ethiopia.

TABLE 2 Knowledge on risky sexual practice of ART patients Wolaita zone Ethiopia, 2023.

S.no	Variable		Frequency	Percent
1	Do you the transmission method of HIV/AIDS	Yes	331	83.2
		No	67	16.8
2	Do you know the prevention of HIV/ Aids	Yes	387	97.2
		No	11	2.8
3	If yes which method of prevention	Use condom	331	83.2
		Absence	67	16.8
4	Do you know the importance of condom	Yes	398	100.0
		No	11	2.8
5	If yes what is the importance of condom	To prevent HIV Aids	332	83.4
		To prevent unwanted pregnancy	55	13.8
		I don't know	11	2.8
6	Do you know the benefit of ART	Yes	376	94.5
		No	22	5.5
7	Do you know the importance of viral load	Yes	343	86.2
		No	55	13.8
	Level of knowledge	Good knowledge	276	69.3
		Poor knowledge	122	30.7

Partner related characteristics

According to the result of the assessment, 244 (61.3%) had sexual partners in the past 6 months, and 211 (53%) had one partner. Regarding the type of sexual partner, 167 (42%) were regular sexual partners. One hundred sixty-six (41.7%) knew the HIV status of their sexual partner, and 111 (45.9%) had an unknown HIV status. One hundred sixty-seven (68.4%) disclosed their status to their sexual partners.

Social support factors

According to the result of the assessment, 209 (52.5% of respondents) had poor social support, while 123 (30.9%) of them had strong social support (Table 3).

Factors associated with risky sexual practice

Results of bivariate logistic regression analysis showed that marital status, age of respondents, residence, having sexual partners, disclosing HIV status to the community, getting counselling, the attitude of ART attendants towards risky sexual practices, using alcohol, knowledge, and social support were candidate variables (which had a *p*-value of less than 0.25). In the multivariable logistic regression analysis, disclosure status, social support, and alcohol use were statistically significant.

In this study, participants who reported not disclosing their HIV status were 1.8 times more likely to risky sexual practice compared to those who disclosed their status. AOR = 1.8, 95% CI (1.3–7.1). Respondents addicted to alcohol were 3.1 times more likely to engage in risky sexual practices as compared to non-alcoholics. AOR = 3.1, 95% CI (1.64–6.023). In this study, participants who had poor social support were 1.9 times more

TABLE 3 Social support status of ART client's Wolaita zone, 2023.

Variable		Frequency	Percent
How many people are so close to you that you can count on them if you have a serious problem?	None	143	35.9
	1–2	99	24.9
	3–5	101	25.4
	>5	55	13.4
How much concern do people show for what you are doing?	A lot of concern and interest	132	33.2
	Some concern and interest	22	5.5
	Uncertain	22	5.5
	Little concern and interest	99	24.9
	No concern and interest	123	30.9
How easy is it to get practical help from neighbors if you should need it?	Very easy	176	44.2
	Easy	22	5.5
	Possible	33	8.3
	Difficult	101	25.4
	Very difficult	66	16.6
Level of social support	Poor social support	209	52.5
	Moderate social support	66	16.6
	Strong social support	123	30.9

likely to engage in risky sexual practices when compared to those with strong social support. AOR = 1.9, 95% CI (1.1–3.31) (Table 4).

Discussion

This study revealed that risky sexual practices among the ART patients was 43.7% and disclosure status, social support, and alcohol use were factors associated with risk of sexual practice.

One hundred seventy-four (43.7%) of ART patients had a risky sexual practice. This finding was relatively similar to the study finding at Gondar University Referral Hospital 3 8% (6), in Ronda 38% (7), Kembata tembaro 40.9% (1) and Addis Abeba public hospital (39.1%) (10). On the other hand, this finding is lower than the findings of other studies in Alibena (61.9% male and 86.3% female) (11), western Oromia 56.9% (12), in Ethiopia (79.8%) (13) and of study participant involved in unprotected sexual practice. And this finding is higher than the findings of other studies in Jamaica (12%) (14) and Vietnam, 3.6% and 5.6% of patients had sexual intercourse with casual partners and sex workers, respectively (15), Ethiopia, (30.4%) (4), in Debrezeit Town 15.8% (2), Northwest of Ethiopia 22.2% (16) and in Nekemet Referral hospital (32.9%) (3). Such differences in the risk of sexual practice being higher or lower than this study

TABLE 4 Associated factors for risky sexual practice among ART clients Wolaita zone, 2023.

Variable		Risky sexual practice		OR (95% confidence interval)		*p*-value
		Yes (*n* = 174)	No (*n* = 224)	COR (95% CI)	AOR (95% CI)	
Sex	Male	44 (49.4%)	45 (50.6%)	1.4 (0.84–2.2)	3.1 (0.3–7.4)	0.97
	Female	130 (42.1%)	179 (57.9%)	1	1	
Age of respondents	18–29	38 (44.7%)	47 (55.3%)	1.3 (0.75–2.3)	1.5 (0.54–4.13)	0.435
	30–39	92 (46.7%)	105 (53.3%)	1.4 (0.9–2.3)	0.953 (0.52–1.76)	0.878
	≥40	44 (37.9%)	72 (62.1%)	1	1	
Marital status	Single	48 (72.7%)	18 (27.3%)	16 (6.1–42.1)	23.02 (0.71–75.23)	0.167
	Married	100 (40.3%)	148 (59.7%)	4.05 (1.8–9.4)	7.97 (0.55–24.9)	0.154
	Divorce	19 (54.3%)	16 (45.7%)	7.13 (2.5–20.2	8.1 (0.4–27.7)	0.43
	Widowed	7 (14.3%)	42 (85.7%)	1	1	
Residence	Rural	158 (46.1%)	185 (53.9%)	2.1 (1.12–3.87)	1.6 (0.7–3.6)	0.194
	Urban	16 (29.1%))	39 (70.9%)	1	1	
Had sexual partners	Yes	115 (47.1%)	129 (52.9%)	1.4 (0.95–2.17)	1.9 (0.98–3.65)	0.56
	No	59 (38.3%)	95 (61.7%)	1	1	
Disclose HIV status to community/people	Yes	101 (39.6%)	154 (60.4%)	1	1	
	No	73 (51.0%)	70 (49.0%)	1.6 (1.05–2.4)	**1.8 (1.3–7.1)***	**0.032**
Get counseling	No	169 (44.9%)	207 (55.1%)	2.8 (1.01–7.68)	1.9 (0.4–8.8)	0.426
	Yes	5 (22.7%)	17 (77.3%)	1	1	
Alcohol use	No	79 (32.4%)	165 (67.6%)	1	1	
	Yes	95 (61.7%)	59 (38.3%)	3.4 (2.2–5.13)	**3.1 (1.64–6.023)***	**0.002**
Attitude	Positive attitude	109 (58.0%)	79 (42.0%)	3.1 (2.04–4.7)	1.2 (0.11–0.45)	0.32
	Negative attitude	65 (31.0%)	145 (69.0%)	1	**1**	
Knowledge	Good	117 (42.4%)	159 (57.6%)	1		
	Poor	57 (46.7%)	65 (53.3%)	1.2 (0.78–1.83)	1.849 (0.483–5.6)	0.435
Social support	Poor	117 (42.4%)	93 (44.5%)	3.01 (1.9–4.9)	**1.9 (1.1–3.31)***	**0.029**
	Moderate	22 (33.3%)	44 (66.7%)	1.21(0.64–2.3)	0.7(0.34–1.67)	0.426
	Strong	36(29.3%)	87(70.7%)	1	1	

Bold values denote AOR and *p*-value for significantly associated factors.
*Significant association.

could be due to the time of the study period, socio-demographic factors, like educational, economic, and cultural factors of the current study area and study settings, composite scoring, and the type of healthcare facilities.

In this study, factors associated with risky sexual practice among ART attendants—disclosure status, social support, and alcohol use—were statistically significant.

In this study, participants who reported not disclosing their HIV status were 1.8 times more likely to practice risky sexual practices compared to those who disclosed their HIV status [AOR = 1.8, 95% CI (1.3–7.1)]. The possible explanation for this finding could be the fact that disclosure of ART clients could decrease risky sexual practices due to the fact that ART patients are more likely to disclose their status.

Another variable, respondents who were addicted to alcohol were 3.1 times more likely to engage in risky sexual behavior than non-alcoholics OR = 3.1, 95% CI (1.64–6.023).This finding is similar to the study conducted in Northern India, which showed that high-risk sexual behavior was nine times more common among patients addicted to alcohol as compared to non-alcoholics (17), in Addis Ababa, respondents who had a history of substance abuse were involved in risky sexual practices more than those who had a history of substance abuse (2), north-west Ethiopia showed that frequent use of alcohol was indecently predictive of unprotected sexual practice (4), and the study conducted in public hospital of Ethiopia revealed that, alcohol consumption was highly associated with unprotected sexual practice (13). The possible explanation for this finding could be the fact that alcohol consumption increases the risky sexual practices of ART patients. Due to the intoxication of ART patients, risky sexual practices were more likely to be engaged, or the fact that alcohol use can hinder the thinking and decision-making abilities about safe sex.

In this study, participants with poor social support were 1.9 times more likely to engage in risky sexual practices when compared to those with strong social support (AOR = 1.9, 95% CI (1.1–3.31).

This study, similar to the study conducted in A Systematic Review of Global Literature on Social Support and HIV Related Risk Practices, suggested that social support was positively associated with consistent condom use (safe sex) among PWHIV (18), in the U.S. indicated that the link between positive support networks and the avoidance of high-risky sexual practices in HIV-positive individuals (19), PWHIV with a high level of perceived HIV-specific support were more likely to consistently use condoms during sexual intercourse (19), A cross-sectional study was done on the effect of social support in the lives of adults with HIV/AIDS (20) and other cross-sectional and prospective predictors study done on unsafe sex among HIV positive individuals in Clark County show that social support has a positive effect on maintaining safe sex (20).

The possible explanation for this finding could be the fact that strong social support decreases the risky sexual practices of ART patients. This may involve identifying an appropriate support or peer group, providing educational materials and counseling, or connecting them to other families or individuals for emotional support.

Limitation of the study

This is a cross-sectional study, and the design does not determine the direction of causality. The sensitive nature of sexuality may result in social desirability bias, which may underestimate the prevalence of risky sexual practices. Again the study could not address the imbalance of male to female ratio which needs further investigation.

Conclusion

In conclusion, the results of the study revealed that the risk of sexual practice among ART clients was high. Disclosure status, social support, and use of alcohol were factors associated with risky sexual practice. Therefore strengthening the disclosure status of ART patients by giving health education via health workers, health program leaders and other governmental and non-governmental organizations working on HIV prevention and treatment, the follow-up of ART patients to decrease the risky sexual practice, the social support of ART clients in order to avoid emotional stress and counseling the ART client to avoid alcohol consumption are needed.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Wolaita Sodo Univesity institutional review board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SS: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Resources, Software, Writing – original draft. BB: Conceptualization, Data curation, Investigation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. EA: Conceptualization, Data curation, Formal Analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. TA: Conceptualization, Data curation,

Investigation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Prevalence and determinants of HIV among reproductive-age women (15–49 years) in Africa from 2010 to 2019: a multilevel analysis of demographic and health survey data

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Background: Human immunodeficiency virus (HIV) remains the leading cause of global morbidity and mortality. The incidence of HIV is disproportionately higher in Sub-Saharan regions, particularly the Southern African sub-region, which is the most affected region and accounts for 77% of all new HIV infections in the region. Thus, the aim of this study was to identify the determinants of HIV among reproductive-age women in Africa.

Methods: This study was conducted among reproductive-age women in Africa, based on secondary data obtained from the Demographic Health Survey (DHS) conducted between 2010 and 2019. The outcome variable was HIV status, while individual- and community-level variables served as potential predictors. The model fit was assessed using Akaike's Information Criterion, Bayesian Information Criterion, and – 2 Log likelihood. Then, multilevel mixed-effects analysis was used. Intra-cluster correlation coefficient, median odds ratio, and proportional change in variance were used to measure heterogeneity between clusters.

Results: A total of 292,810 unweighted and 293,773 weighted reproductive-age women in 26 African nations were included in this study. The overall prevalence of HIV among reproductive-age women in Africa was 4.34% (95% CI: 4.2, 4.4%). The highest percentage of HIV was found in Lesotho (23.98%), followed by South Africa (19.12%), and Mozambique (14.67%). However, the lowest HIV prevalence was found in Niger (0.54%), Senegal (0.59%), and Burundi (0.79%). Southern Africa has the highest HIV burden (18.5%), followed by Eastern Africa (6.1%), while Western African countries have the lowest HIV burden. Increasing maternal age, higher maternal education, women who were unemployed, a history of multiple sexual partners, women in a union, community-level educational status, community-level wealth index, African sub-region, and urban residence were found to be independent predictors of HIV infection in Africa.

Conclusion: The burden of HIV has remained higher, highlighting the need for targeted public health intervention strategies to prevent the transmission of HIV among key populations.

KEYWORDS

Africa, DHS, HIV, multilevel analysis, reproductive-age women

1 Introduction

Human immunodeficiency virus (HIV) is a type of virus that attacks the human immune system, causing a decrease in CD4+ cell counts and immune function, which leads to AIDS and other life-threatening opportunistic infections (1). Globally, since the start of the HIV epidemic, approximately 85.6 million individuals have been infected with HIV, and 40.4 million have died from AIDS-related illnesses. According to recent evidence, an estimated 39 million people were living with HIV (PLWHIV) in 2022, of whom approximately 1.3 million were newly infected. Global HIV and AIDS statistics show that women and girls accounted for 53% of all PLWHIV and 46% of all new infections in 2022. Surprisingly, young women and adolescent girls accounted for more than 77% of all new HIV infections in Sub-Saharan Africa (SSA) (2). Moreover, out of the global new HIV infections that were reported per day, two out of three cases were reported in SSA (3), and the Joint United Nations Program on HIV/AIDS (UNAIDS) reports that three new HIV infections and one AIDS-related death occur every minute (4). The likelihood of acquiring HIV in these target groups was more than three times higher than among their male peers (2).

Across different geographies, national boundaries, and even within individual provinces, the HIV epidemic has shown striking variation (5). The largest concentration of HIV-positive individuals is found in SSA, especially in Southern Africa (6). However, considering population size, the Northeast has the highest prevalence of HIV-positive individuals. Research from Southern Africa indicates that sexual interactions between adolescent girls or young women and older men are a common way of HIV transmission. Furthermore, children born to HIV-positive mothers are at risk of contracting the virus if their mothers are not receiving effective treatment or are not being monitored (6, 7).

Globally, HIV continues to be the primary cause of morbidity and mortality. There is mounting evidence that HIV/AIDS-related maternal deaths have significantly increased; however, it is challenging to determine the true contribution of HIV/AIDS to maternal mortality because pregnant women's HIV status is not usually recognized. This causes an underestimation of the data. AIDS has surpassed direct obstetric reasons as the primary cause of maternal mortality in several countries with high HIV incidence (8, 9). Different factors have been associated with the escalating prevalence of HIV among reproductive-age women. Some of the drivers of HIV are women who are separated from their spouses, and who travel long distances to reach health facilities, with a low level of wealth, and poor media exposure (9).

As a long-time partner of the Global Fund to Fight AIDS, the United Nations Development Program (UNDP) remains committed to helping nations achieve the Sustainable Development Goals (SDGs) through its HIV, Health Strategy, and Strategic Plan 2022–2025 (10). However, inequalities hamper the AIDS response, with key populations accounting for 70% of new HIV infections globally and 51% of new infections in sub-Saharan Africa (11). Moreover, there is a substantial funding gap in Africa's HIV response; however, some countries like Botswana, Eswatini, Rwanda, Tanzania, and Zimbabwe are progressing toward the 95–95-95 targets. Despite this progress, a significant number of people and communities, including women, girls, and key populations, still lack access to HIV services due to gender inequalities, discrimination, violence, stigma, and harmful laws. Thus, the situation is worsened by the criminalization of HIV-positive individuals and high-risk groups, with many nations still restricting access to HIV-related health care for marginalized populations, which further exacerbates the burden of HIV (12).

To provide evidence-based HIV care and services in resource-constrained regions, comprehensive evidence is required. However, the available evidence is scarce and often not generalizable to the African region. Thus, comprehensive evidence using big data is quite important. Moreover, cluster-level factors are very important for appropriate public health interventions among the selected target groups. Therefore, this study aimed to estimate the prevalence of HIV and to identify its associated factors among women of reproductive age in Africa using the most recent Demographic and Health Survey (DHS) conducted in 2010 and later data.

2 Methods

2.1 Study setting, population, and data sources

This study is a secondary analysis of recent demographic and health survey (DHS) data from African countries. The DHS is conducted every 5 years. Among all African countries, only 26 countries had a record of routine HIV test results among reproductive-age women in their DHS dataset (Table 1, Figure 1). The DHS is primarily conducted in low- and middle-income countries and is a nationally representative survey. Data from each DHS were collected using a cross-sectional study design from 2010 to 2019, as shown in Table 1. Women living in Africa were considered the source population, while the study population for the current study consisted of women aged 15–49 years who lived in Africa and had complete HIV blood test results. The DHS dataset of 26 African

Abbreviations: AOR, Adjusted odds ratio; BIC, Bayesian Information Criterion; CSA, Central Statistical Agency; DHS, Demographic and Health Survey; EAs, Enumeration Areas; HIV, Human Immune Deficiency Virus; ICC, Intra-cluster correlation coefficient; MOR, Median Odds Ratio; SSA, Sub-Saharan Africa; PCV, Proportional Change in Variance; UNAIDS, United Nations Program on HIV/AIDS; VIF, Variance inflation factor.

TABLE 1 DHS survey years by country.

Country	Survey year	Country	Survey year
Angola	2015/16	Mali	2012/13
Burkina Faso	2010	Malawi	2015/16
Burundi	2016/17	Mozambique	2015
Democratic Republic of Congo	2013/14	Niger	2012
Cote d'Ivoire	2011/12	Namibia	2013
Cameroon	2018/19	Rwanda	2014/15
Ethiopia	2016	Sierra Leone	2019
Gabon	2019	Senegal	2017
Ghana	2014	Chad	2014/15
Gambia	2013	Togo	2013/14
Guinea	2018	South Africa	2016
Liberia	2013	Zambia	2018/19
Lesotho	2014	Zimbabwe	2015

countries was appended together to determine the burden of HIV and its drivers forces among reproductive-age women (15 to 49 years of age). For this study, we used an individual (women) record (IR) file and an HIV testing recode (AR) file. Finally, reproductive-age women who had complete HIV blood test results were included. In each DHS, a two-stage stratified sampling technique was used during participant selection. Enumeration areas (EAs) and households were selected in the first and second stages, respectively. The selection process for most DHSs involved unequal probabilities, requiring the use of weighting. Thus, we weighted our samples using the individual weight of women to increase the representativeness of the data. Weighting was performed by dividing the individual weight of women (v005) by 1 million. Data abstraction was carried out from 31 October 2023 to 30 November 2023, following the acquisition of the necessary ethical approval from the DHS. Consent from participants was waived for access to their previously collected data from the DHS.

2.2 Study variables

The HIV test result was the outcome variable of this study, where it was classified as "Yes" when the HIV result of reproductive-age women was positive and coded as 1, otherwise "No" and coded as 0. Moreover, both individual and community-level data were considered as potential predictor variables of HIV prevalence among reproductive-age women in Africa. Individual-level (level I) variables included socio-demographic (age, marital status, educational status, occupational status, sex, and age of household head), HIV testing history, pregnancy status, age at first sexual intercourse, and economic characteristics (wealth index). Community-level (level II) variables included common characteristics of study subjects in an enumeration area, such as countries in the African region (East, West, Central, and South African regions), community-level media exposure (exposed versus unexposed), community-level women's education (low versus high), community-level poverty or wealth index (low versus high), and residence (urban versus rural) (Figure 2).

2.3 Operational definition of the variables

- Community-level media exposure: It is defined as the exposure to media among women who were either listening to the radio, reading a newspaper or magazine, watching television, or using the Internet at least once a week (13).
- Community-level poverty or wealth index: It is defined as higher and lower poverty using the mean value of individual women's wealth index.
- Community-level women's education: It is defined based on the average proportion of educational level in the community as lower and higher educational attainment.

2.4 Data management and statistical analysis

The variables were extracted from IR and AR files, and STATA version 17.0 was used to clean, recode, and analyze the data. The individual (women's) recode (IR files) from each of the 26 African countries was first merged with the HIV testing recode (AR files). Then, the merged IR and AR files from each of the 26 countries were pooled by appending the datasets together. The dataset was weighted using sample weights to compensate for the unequal probability of the strata selection process. Taking into account the hierarchical character of the data, a multilevel mixed-effects model was used to assess the fitness of the model for performing multilevel analysis. Thus, the measure of variation or random effect between clusters was assessed using the intra-cluster correlation coefficient (ICC), the median odds ratio (MOR), and the proportional change in variance (PCV) (14). The intraclass correlation coefficient (ICC), which shows the degree of heterogeneity in HIV prevalence between clusters, was calculated using the formula: $\mathrm{ICC} = \frac{\delta 2}{\delta 2 + \pi/3}$; $\mathrm{ICC} = \frac{\delta 2}{\delta 2 + 3.29}$, where δ2 indicates the estimated variance of the clusters. The MOR between two women with higher and lower propensity among two randomly chosen clusters can be compared, and it measures unexplained cluster heterogeneity of HIV distribution, which is calculated as $\mathrm{MOR} = \exp\left(\sqrt{2 * \delta 2} * 0.6745\right) or\ \mathrm{MOR} = \exp\left(0.95 * \delta\right)$, where δ^2 is the cluster-level variance. Moreover, the PCV measured the total variation in HIV distribution explained by individual- and community-level variables, which was calculated as $\mathrm{PCV} = \frac{\delta 2 \text{null model} - \delta 2 \text{ of each model}}{\delta 2 \text{null model}}$, where δ2 of the null model was used as a reference.

A multilevel mixed-effects regression model was computed to find predictors of HIV among reproductive-age women in Africa. To detect the existence of a potential contextual effect, four models were fitted, the first being a null model (model I), the second being an adjustment for individual-level variables (model II), the third being an adjustment for community-level variables (model III), and the fourth being an adjustment for both

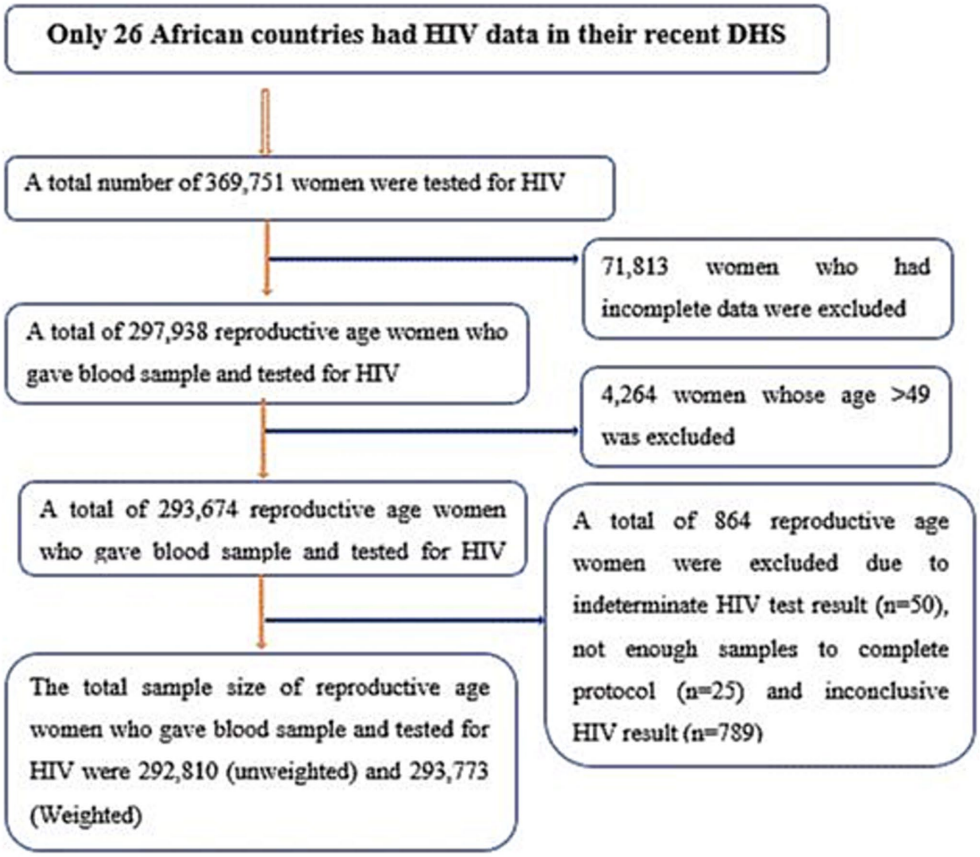

FIGURE 1
Schematic representation of the sampling procedure for this study.

individual and community-level variables (model IV). Deviation (−2Log likelihood), Akaike's Information Criterion (AIC), and Bayesian Information Criterion (BIC) were used to compare the models because the models were nested. Finally, the fourth model (model IV) with the smallest information criterion value was chosen as the final best-fit model. In the final model, both community- and individual-level variables with a p-value ≤0.25 in the bi-variable analysis were included in the multivariable model. Finally, variables with an adjusted OR (AOR) with 95% CI and $p < 0.05$ were considered statistically significant predictors of HIV among reproductive-age women in Africa. Furthermore, multicollinearity was examined using the variance inflation factor (VIF) test and tolerance. All variables had a VIF < 10 and tolerance less than 1, indicating that multicollinearity did not exist.

2.5 Ethical considerations

Ethical approval was obtained from the Research and Ethics Review Committee of the Wollo University, College of Medicine and Health Sciences. The data from the Demographic and Health Survey were used for this study with permission obtained from the Measure DHS program at https://dhsprogram.com/ after registering and submitting a request with a brief statement of the objectives of the study. The data were used only for this registered research and cannot be shared with other researchers.

3 Results

3.1 Socio-demographic characteristics and HIV distribution

A total of 292,810 unweighted reproductive-age women were included in this study. Approximately 35, 398 (20.1%) of the women were aged between 35 and 39 years, which was the largest group. On average, the women reported an age at first sexual intercourse of 13.6 years, with a standard deviation of 7.17 years. The average age at first birth was 19.3 years, with a standard deviation of 3.88 years. Similarly, 45,014 (15.3%) women had no previous history of sexual exposure, of whom 1,705 (19.8%) women were found to be HIV positive. Approximately 46.4% of the women had a history of multiple sexual partners, and 5.6% of these women tested positive for HIV, compared to 3.5% of women without multiple partners. In terms of wealth index, 51,895(17.7%) and 54,208(18.5%) of women, respectively were poorest and poorer. Furthermore, 98,366 (31.5%) women had no formal education, of which 2.0% of them were HIV positive (Table 2).

3.2 HIV among reproductive-age women (15–49 years) in Africa

The prevalence of HIV among reproductive-age women in Africa was 4.34% (95% CI: 4.2, 4.4%). The predominant frequency

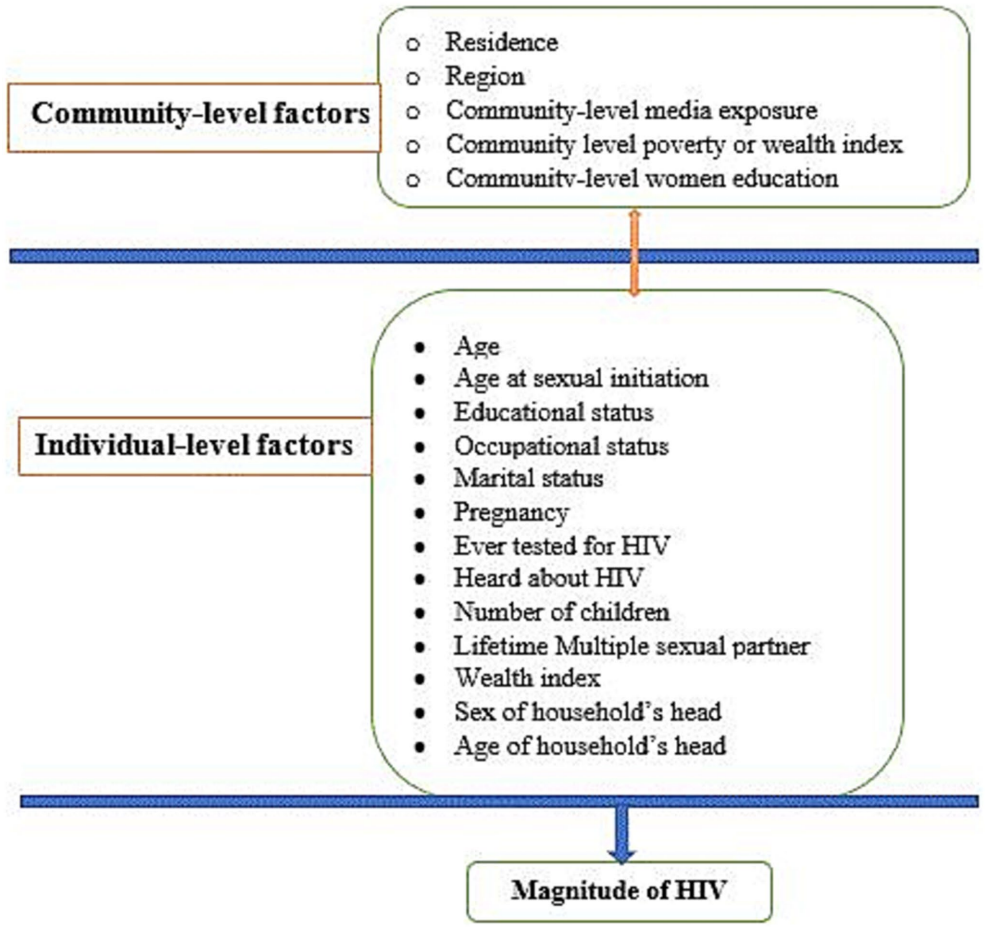

FIGURE 2
Conceptual framework showing factors associated with HIV among reproductive-age women in Africa.

of HIV was reported in Lesotho (23.98%), followed by South Africa (19.12%) and Mozambique (14.67%). In contrast, less than 1% of HIV prevalence was reported in Niger (0.54%), Senegal (0.59%), and Burundi (0.79%) (Table 3). Among African sub-regions, the highest proportion of reproductive-age women tested for HIV was found in Western Africa (39.4%) and the lowest was in Southern Africa (7.4%). HIV was predominant in Southern African (18.5%) followed by Eastern African (6.1%) countries. The lowest level of HIV was observed in Western African countries (Table 3).

3.3 Multilevel mixed-effects analysis of HIV among reproductive-age women in Africa

The random effects analysis showed that the ICC value in the null model (model I) was 0.49, indicating that 49% of the variability in HIV status was due to between-cluster/EA variability, while 51% was attributable to individual differences. Moreover, the full model accounted for 35% of the variation in HIV status among reproductive-age women in Africa. The variance between clusters (EA) in the null model (model I) was also 3.17, showing significant variability in HIV status. After accounting for individual and community-level factors, model IV revealed substantial variability in the odds of developing an HIV infection among women of reproductive age in Africa. This finding was further supported by the MOR results. Model fitness was evaluated using -2Log likelihood, Akaike's Information Criterion (AIC), and Bayesian Information Criterion (BIC). Finally, model IV was chosen as the best-fit model as it had the lowest AIC (83249.11), the lowest BIC (83433.08), and the highest Log-likelihood (−41606.55) (Table 4).

In the fixed effects analysis of the final model (model IV), multiple factors from individual and community-level variables were statistically associated with HIV status. The likelihood of developing HIV infection was 2–2.49 times higher among women who had a higher educational status [AOR, 2.49, 95% CI (2.16, 2.9)] than among women with no education. Similarly, the odds of developing HIV infection among reproductive-age women whose age group ranged from 35to 39, 40 to 44, and 45 to 49 years were 1.4, 1.5, and 1.75 times higher, respectively, than among women aged 15–19 years. Moreover, reproductive-age women who were not in a union were 10% less likely to develop HIV infection compared to those who were in a union [AOR, 0.9, 95% CI (0.85, 0.98)]. The odds of developing HIV among women who had a lifetime history of multiple sexual partners were 1.3 times higher than those who did not have multiple sexual partners [AOR, 1.3, 95% CI (1.26, 1.41)]. Additionally, women who

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TABLE 2 Background characteristics of study participants and HIV status by various background characteristics among reproductive-age women in Africa.

Variable	Category	Weighted frequency	HIV status	
			Negative no (%)	Positive no (%)
Women's age	Mean ± SD	28.5 ± 9.45		
Women's age at first delivery	Mean ± SD	19.3 ± 3.88		
Women's age at first sexual intercourse	Mean ± SD	13.6 ± 7.17		
Head of household	Mean ± SD	44.6 ± 14.28		
Maternal age	15–19	61,994 (21.1)	59,322 (95.7)	2,672 (4.3)
	20–24	54,561 (18.6)	52,104 (95.5)	2,457 (4.5)
	25–29	51,706 (17.6)	49,536 (95.8)	2,170 (4.2)
	30–34	42,683 (14.5)	40,929 (95.9)	1754 (4.1)
	35–39	35,398 (20.1)	33,821 (95.6)	1,576 (4.4)
	40–44	26,365 (8.9)	25,207 (95.6)	1,158 (4.4)
	45–49	21,067 (7.2)	20,100 (95.4)	966 (4.6)
Age at first sexual intercourse	Did not have sex	45,014 (15.3)	43,309 (80.2)	1705 (19.8)
	<15 yrs	141 (0.05)	125 (88.7)	16 (11.3)
	>15	66,741 (22.7)	63,731 (95.5)	3,010 (4.5)
	Did not remember	181,876 (61.9)	173,854 (95.6)	8,022 (4.4)
Total number of children delivered	0	80,519 (27.4)	77,138 (95.8)	3,381 (4.2)
	1–3	115,781 (39.4)	109,822 (94.9)	5,959 (5.1)
	>3 (mean)	97,472 (33.2)	94,060 (96.5)	3,412 (3.5)
Maternal education	Illiterate	98,366 (31.5)	96,374 (98.0)	1991 (2.0)
	Primary	86,453 (29.4)	82,038 (94.9)	4,415 (5.1)
	Secondary	95,649 (32.6)	90,048 (94.1)	5,602 (5.9)
	Higher	13,305 (4.5)	12,560 (94.4)	745 (5.6)
Ever tested for HIV	No	138,700 (47.3)	134,994 (97.3)	3,706 (2.7)
	Yes	154,572 (52.7)	145,538 (94.2)	9,034 (5.8)
MSP	No	133,317 (53.6)	128,689 (96.5)	4,628 (3.5)
	Yes	115,277 (46.4)	108,870 (94.4)	6,407 (5.6)
Sex of head of household	Male	210,333 (71.6)	202,186 (96.1)	8,147 (3.9)
	Female	83,440 (28.4)	78,834 (94.5)	4,606 (5.5)
Currently pregnant	No	268,462 (91.4)	256,669 (95.6)	11,793 (4.4)
	Yes	25,311 (8.6)	24,351 (96.2)	960 (3.8)
Heard about HIV	No	15,691 (5.5)	15,252 (97.2)	439 (2.8)
	Yes	267,107 (94.5)	255,058 (95.5)	12,049 (4.5)
Marital status	Not formerly in a union	85,926 (29.2)	81,611 (95.0)	4,315 (5.0)
	In a union	207,847 (70.8)	199,409 (95.9)	8,438 (4.1)
Wealth index	Poorest	51,895 (17.7)	49,724 (95.8)	2,171 (4.2)
	Poorer	54,208 (18.5)	51,847 (95.6)	2,361 (4.4)
	Middle	56,640 (19.3)	54,203 (95.7)	2,437 (4.3)
	Richer	61,920 (21.0)	59,071 (95.4)	2,849 (4.6)
	Richest	69,110 (23.5)	66,174 (95.8)	2,936 (4.2)
Residence	Urban	118,633 (40.4)	112,991 (95.2)	5,642 (4.8)
	Rural	175,140 (59.6)	168,029 (95.9)	7,111 (4.1)
Media exposure	Exposed	92,308 (31.4)	88,794 (96.2)	3,514 (3.8)
	Not exposed	201,465 (68.6)	192,226 (95.4)	9,239 (4.6)

(Continued)

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TABLE 2 (Continued)

Variable	Category	Weighted frequency	HIV status	
			Negative no (%)	Positive no (%)
Occupation	Unemployed	128,564 (43.8)	122,047 (94.9)	6,517 (5.1)
	Employed	165,209 (56.2)	158,973 (96.2)	6,236 (3.8)
Ever heard of sexually transmitted infections (STIs)	No	13,462 (4.8)	13,101 (97.3)	362 (2.7)
	Yes	269,319 (95.2)	257,193 (95.5)	12,126 (4.5)

TABLE 3 HIV status by country of residence among reproductive-age women in Africa.

Country	Distribution of study participants					
	HIV positive		HIV negative		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Angola	282	2.29	12,036	97.7	12,318	4.2
Burkina Faso	170	1.05	15,951	98.9	16,121	5.5
Burundi	136	0.79	17,085	99.2	17,221	5.9
Democratic Republic of Congo	200	1.11	17,802	98.9	18,002	6.1
Cote d'Ivoire	361	3.74	9,279	96.3	9,640	3.3
Cameroon	410	3.03	13,110	97.0	13,520	4.6
Ethiopia	234	1.49	15,446	98.5	15,680	5.3
Gabon	398	4.02	9,497	96.0	9,895	3.4
Ghana	156	1.71	8,941	98.3	9,097	3.1
Gambia	141	1.69	8,189	98.3	8,330	2.8
Guinea	131	1.46	8,847	98.5	8,978	3.1
Liberia	120	1.42	8,343	98.6	8,463	2.9
Lesotho	1,508	23.98	4,781	76.0	6,289	2.1
Mali	94	1.02	9,088	99.0	9,182	3.1
Malawi	1,340	9.55	12,688	90.4	14,028	4.8
Mozambique	1,013	14.67	5,890	85.3	6,903	2.3
Niger	48	0.54	8,917	99.5	8,965	3.1
Namibia	1,186	13.89	7,353	86.1	8,539	2.9
Rwanda	355	2.63	13,142	97.4	13,497	4.6
Sierra Leone	219	1.64	13,115	98.4	13,334	4.5
Senegal	86	0.59	14,411	99.4	14,497	4.9
Chad	189	1.62	11,442	98.4	11,631	4.0
Togo	191	2.05	9,127	98.0	9,318	3.2
South Africa	1,300	19.12	5,498	80.9	6,798	2.3
Zambia	1,536	11.29	12,064	88.7	13,600	4.6
Zimbabwe	949	9.56	8,978	90.4	9,927	3.4
African sub-region						
Eastern Africa	5,563	6.1	85,292	93.9	90,855	30.9
Central Africa	1,479	2.3	63,887	97.7	65,366	22.3
Southern Africa	3,995	18.5	17,633	81.5	21,628	7.4
Western Africa	1716	1.5	114,208	98.5	115,924	39.4
Total	12,753	4.34	281,020	95.7	293,773	100

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TABLE 4 Multivariable multilevel mixed effect analysis results of individual- and community-level factors associated with the prevalence of HIV among reproductive-age women in Africa.

Variable	Category	Model II	Model III	Model IV
Maternal age	15–19	1		1
	20–24	0.95 (0.87–1.04)		1.01 (0.92–1.1)
	25–29	0.98 (0.88–1.1)		1.07 (0.96–1.19)
	30–34	1.04 (0.93–1.2)		1.1 (1.04–1.31)
	35–39	1.22 (1.09–1.38) **		1.4 (1.2–1.57) ***
	40–44	1.27 (1.12–1.44) ***		1.5 (1.3–1.7) ***
	45–49	1.47 (1.28–1.68) ***		1.75 (1.5–2.04) ***
Maternal education	Illiterate	1		1
	Primary	2.2 (2.1–2.38) ***		2.25 (2.1–2.4) ***
	Secondary	2.17 (1.99–2.37) ***		2.45 (2.2–2.7) ***
	Higher	1.98 (1.73–2.29) ***		2.49 (2.16–2.9) ***
Ever tested for HIV	No	1		1
	Yes	1.9 (1.8–2.1) ***		1.08 (1.0–1.16)
Multiple sexual partners	No	1		1
	Yes	1.27 (1.2–1.3) ***		1.3 (1.26–1.41) ***
Sex of head of household	Male	1		1
	Female	1.14 (1.08–1.2) ***		1.01 (0.95–1.05)
Currently pregnant	No	1		1
	Yes	0.9 (0.8–1.1)		0.97 (0.87–1.07)
Heard about HIV	No	1.32 (1.1–1.5) **		1.08 (0.9–1.25)
	Yes	1		1
Union status	Never in a union	1.21 (1.1–1.3) ***		0.9 (0.85–0.98) **
	In a union	1		1
Occupation	Unemployed	1.42 (1.35–15) ***		1.1 (1.04–1.17) **
	Employed	1		1
Wealth index	Lower		1	1
	Higher		1.15 (1.07–1.22) ***	1.14 (1.04–1.25) **
Residence	Urban		1	1
	Rural		0.77 (0.7–0.84) ***	0.8 (0.73–0.87) ***
Media exposure	Exposed		1	1
	Not exposed		1.02 (0.96–1.08)	1.03 (0.96–1.1)
Sub-region	East Africa		4.6 (4.2–5.0) ***	4.13 (3.76–4.5) ***
	Central Africa		1.4 (1.3–1.6) ***	1.18 (1.05–1.34) **
	South Africa		14.3 (13.1–15.6) ***	10.6 (9.5–11.8) ***
	West Africa		1	1
Women's education	Lower		1	1
	Higher		1.12 (1.05–1.2) ***	1.17 (1.09–1.31) *
Random effects model				
ICC (%)	0.49	0.42	0.37	0.35
Variance (SE)	3.17 (1.0051)	2.34 (0.71682)	1.97 (0.77132)	1.78 (0.82684)
MOR (%)	Exp (3.0115)	Exp (2.223)	Exp (1.8715)	Exp (1.691)
PCV	Reference	26.2%	37.8%	43.8%
Model fitness				
-2Log likelihood	−56,819	−45253.36	−50005.61	−41606.55

(Continued)

TABLE 4 (Continued)

Variable	Category	Model II	Model III	Model IV
AIC	113643.8	90534.72	100023.2	83249.11
BIC	113665.1	90680.92	100085.5	83433.08

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; AIC, Akaike's Information Criterion; BIC, Bayesian Information Criterion; ICC, Intra-cluster correlation coefficient; MOR, median odds ratio; PCV, proportional change in variance.
Model I is the null model, a baseline model without any explanatory variable.
Model II is adjusted for the individual level.
Model III is adjusted for community-level variables.
Model IV is the final model adjusted for all explanatory variables and country of survey.

were unemployed had a 1.1 times higher likelihood of being HIV-positive than those who were employed [AOR, 1.1, 95% CI (1.04, 1.17)]. When considering community-level factors, reproductive-age women who had a higher wealth index and higher community-level education, respectively, were 1.14 times [AOR = 1.14; 95% CI (1.04, 1.25)] and 1.17 times [AOR, 1.17, 95%CI (1.09, 1.31)] more likely to be infected by HIV than their counterparts. Rural residence was associated with 80% lower odds of HIV infection compared to urban residence [AOR 0.8, 95% CI (0.73, 0.87)]. Furthermore, women who lived in Southern Africa, Eastern Africa, and Central Africa had a 10 times higher likelihood [AOR, 10.6, 95% CI (9.5, 11.8)], a four times higher likelihood [AOR, 4.13, 95% CI (3.76, 4.5)], and a 1.18 times higher likelihood [AOR, 1.18, 95% CI (1.05, 1.34)], respectively, of being HIV-positive than women who lived in Western African countries (Table 4).

4 Discussion

This study aimed to investigate the prevalence of HIV and its individual and community-level determinants among reproductive-age women in Africa based on DHS data collected from 2010 to 2019. The overall findings of the present study reveal that a significant regional variation in HIV among African countries is associated with both individual and community-level factors, which further indicates the complex nature of HIV transmission.

The overall prevalence of HIV among reproductive-age women in Africa was 4.34% (95% CI: 4.2, 4.4%), which was lower than the 6.5% HIV prevalence in SSA (15). The current point estimate suggests that the prevalence of HIV declined more rapidly in this target group compared to surveys conducted from 2003 to 2012 in SSA. This variation could be attributed to differences in the time periods, where different public health interventions implemented after 2012 may have contributed to a reduction in HIV transmission. Moreover, the findings of the current study showed a higher prevalence than the 0.85% prevalence of HIV reported in Ethiopia (9). The higher prevalence in the current study may be due to the inclusion of data from highly HIV-endemic areas, which likely contributed to the increased HIV prevalence in South African countries. Furthermore, the prevalence of HIV in this study was lower than the 10.3% HIV prevalence reported in Mozambique (16). This could be because the prevalence of HIV burden was higher in the Southern region of SSA where Mozambique is located (17). This finding also suggests the role of geographic locations in the transmission of HIV.

The predominant burden of HIV was reported in Lesotho (23.98%), which is consistent with the 27.9% HIV prevalence reported in a recent 2020 Lesotho Population-Based HIV Impact Assessment (LePHIA) among women. This finding implies that the burden remains alarming, with more than one-fourth of women from Lesotho infected with HIV. Similarly, the second predominant prevalence of HIV was found in South Africa (19.12%). This statistical figure suggests that nearly one in five South African women is living with HIV. Thus, the burden of HIV in this region is enormous and requires an integrated, multisectoral collaboration to alleviate HIV transmission. Furthermore, the lowest prevalence of HIV was reported in Niger (0.54%) and Senegal (0.59%), which is supported by previous findings that reported HIV prevalence ranging from 0 to 2% (18).

The current study confirmed that the predominant HIV burden in the Southern African region (18.5%) was followed by Eastern African countries (6.1%). The high burden of HIV in the Southern African region could be due to the socio-political environment, cultural variations, and risk behaviors that increase vulnerability to HIV acquisition and transmission. Furthermore, this rate suggests that the overall decline is not yet fast enough to achieve the UNDP's 2025 95–95-95 targets, and may be an indication of the failure of targeted public health interventions in the region (19). Moreover, the lowest HIV prevalence was found in the Western African region (1.5%), which may be explained by the effectiveness of targeted HIV prevention interventions among key populations such as female sex workers (20).

Moreover, women who had a history of multiple sexual partners (more than two) had approximately a 1.3 times higher likelihood of HIV infection than their counterparts. This may be due to the fact that HIV infection is a sexually transmitted infection (STI), and the risk of transmission increases with the duration of sexual activity and the number of sexual partners. As a result, these behaviors encourage the spread of STIs, particularly HIV. Therefore, having several sexual partners in a close-knit social network increases the chance of contracting STIs, as it facilitates the virus's rapid transmission (21). If multiple sexual partnerships are due to engagement in transactional sex for material or financial benefits, women may be less likely to insist on safer sex practices, thereby increasing the risk of HIV transmission. Similarly, the odds of HIV infection were lower among women who were never in a union than those women who were in a union or living together. This could be due to higher sexual exposure among women in a union, which is the key mode of HIV transmission.

Furthermore, women with higher educational status had an increased likelihood of HIV infection than their counterparts and this was statistically significant. This evidence disagreed with findings from South Africa (22), which may be due to the risk exposure difference of the women included in the study, along with the change in the study period. The statistical linkage may be due to the fact that more educated women are likely to be wealthier and more mobile,

migrating from rural to urban areas where HIV is more endemic. Additionally, they may have more sexual partners or networks (23).

Similarly, unemployed women had a higher likelihood of acquiring HIV than their counterparts, which is supported by a previous study in SSA (24). This could be because unemployed women are more likely to be the poorest, and they may engage in high-risk behaviors including commercial sex work to alleviate their financial problems, which further increases their vulnerability to acquiring HIV infection. As a result, the odds of HIV infection were higher among women with a higher wealth index, which is supported by previous findings in Ethiopia (9) and SSA (24). Women with a higher wealth index are more likely to be educated and mobile, often living in urban areas where the endemicity of HIV is high.

The prevalence of HIV was lower among rural women than among urban dwellers, showing a disproportionately higher concentration of HIV/AIDS found in urban areas, in agreement with the findings of existing studies (9, 25, 26). This disproportionately lower prevalence in rural areas may be due to the expansion of injecting drug use, increased rates of drug-related activities, and levels of social interaction, all of which can significantly impact the patterns of women's sexual interaction. Moreover, commercial sex activities (9, 25) and non-regular sexual relations are reported to be higher in urban areas than in rural ones. The population distribution, such as the male predominance in urban areas, may increase the extent of commercial sex activities. All of these conditions favor the transmission of HIV (25).

The rate of HIV among reproductive-age women varies considerably across Africa. The rate of infection is lower in West African countries than in other areas of SSA. However, the clear reasons for this change in epidemiological patterns of HIV/AIDS in Africa are not well understood. The most likely reasons for the increased likelihood of HIV infection exposure among South African women include limited access to sexually transmitted infection treatment opportunities, women engaging in heterosexual practices that increase the risk of recent infection, intergenerational sex, and the highest rates of pregnancy (27). Moreover, the effect of poverty may escalate the transmission of HIV in Eastern and Southern African countries, because HIV/AIDS can strike both the poor and the rich; however, the prevalence varies between these groups. In addition to this, the burden of financial problems in these regions may increase the vulnerability of women, because they may be exposed to the exchange of sex for money (28). Furthermore, the higher prevalence of HIV in South Africa is associated with ethnicity-based inequalities that accelerate the transmission of HIV in a certain marginalized population. The socio-political-economic system has been another driving force of HIV in this region (22, 29, 30). The implication of this study is to develop an appropriate evidence-based public health intervention of HIV among key populations in Africa. This study produced strong evidence using a large sample size, which may be significant for generalizability. However, the present study has certain limitations. For instance, due to the cross-sectional nature of the design employed by the DHS, causality could not be established. The time frame and the regional variation may be another limitation. Since the study uses data from 2010 to 2019, it may not reflect the current trend and status of HIV. The difference in sociocultural variations in Africa may not be equally applicable. Moreover, the trends of HIV over time in each country cannot be understood due to the lack of longitudinal data.

5 Conclusion

The prevalence of HIV among reproductive-age women was still high and was disproportionately higher in Southern African countries. Higher maternal education and wealth index, older maternal age, unemployment, sub-Saharan region, a history of multiple sexual partners, being in a union, and being an urban dweller were the predictors of HIV infection. Therefore, healthcare professionals and other concerned stakeholders should work on women's empowerment, healthcare service expansion, and promoting their evidence-based public health intervention strategy for preventing the transmission of HIV among these key populations. Overall, a multisectoral response is warranted to meaningfully reduce the ongoing HIV burden faced by women across the African continent through women empowerment in education, economic opportunities, healthy relationships, and accessible prevention/treatment services.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: https://dhsprogram.com/.

Ethics statement

The studies involving humans were approved by the Demographic and Health Surveys (DHS) Program. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because the data was a secondary data where participants couldn't directly participate in the study.

Author contributions

AG: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AME: Conceptualization, Investigation, Methodology, Resources, Software, Writing – review & editing. AM: Conceptualization, Formal analysis, Investigation, Project administration, Resources, Software, Writing – review & editing. AA: Formal analysis, Methodology, Resources, Software, Validation, Writing – review & editing. DM: Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Validation, Writing – review & editing. EA: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – review & editing. FB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Software, Supervision, Validation, Writing – review & editing. FBG: Validation, Visualization, Writing – original draft, Writing – review & editing, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision. LA: Data curation, Formal analysis, Project administration, Resources, Software, Visualization, Writing – review

& editing. AE: Data curation, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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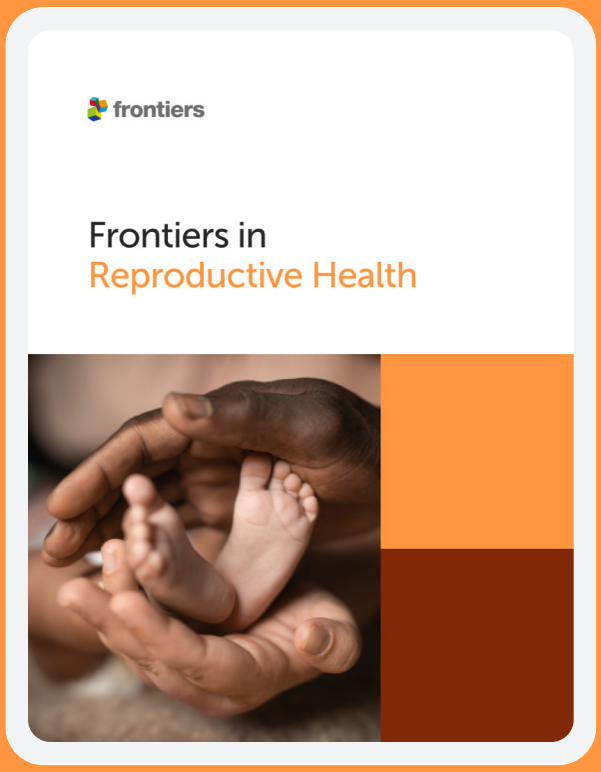

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